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THE CLASSIFICATION OF CLIMATES: I.*

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SYNOPSIS.

Need of a Classification of Climates.—Relation of Continental and Ocean Areas to Temperature: reasons for the slow change in the temperature of ocean waters.—Marine or Oceanic Climate.—Continental Climate.—Desert Climate.—Coast or Littoral Climate.—Monsoon Climate.—Mountain and Plateau Climate.—Mountains as Climatic Divides.

Need of a Classification of Climates.—A broad division of the earth's surface into zones is necessary as a first step in any systematic study of climate, but it is not satisfactory when a more detailed discussion is undertaken. The reaction of the physical features of the earth's surface upon the atmosphere complicates the climatic conditions found in each of the zones, and makes further subdivision desirable. Under the control of these different physical conditions the climatic elements unite to produce certain fairly distinct types of climate, and these may be classified in various ways. The usual method is to separate the *continental* (near sea-level) and the *marine*. An extreme variety of the continental is the *desert;* a modified form, the *littoral;* while altitude

* It is the object of this article to give a brief summary of the general climatic types which result from the control of land and water, and of altitude, over the more important elements of climate.

The following references have been consulted, in addition to those given in later foot-notes:

W. M. Davis: Elementary Meteorology, Boston, 1894, 335–344.

J. Hann: Handbook of Climatology. Translated by R. DeC. Ward. London and New York, 1903, 128–180, 222–374.

W. Köppen: Klimalehre, Leipzig, 1899, 93–104.

W. J. van Bebber: Hygienische Meteorologie, Stuttgart, 1895, 247–254.

is so important a control that *mountain* and *plateau* climates are further grouped by themselves.

Relation of Continental and Ocean Areas to Temperature.—Land and water differ greatly in their behaviour regarding absorption and radiation. The former warms and cools readily, and to a considerable degree; the latter, slowly and but little. (1) Of the insolation which falls upon the ocean a good deal is at once reflected, and is therefore not available for warming the water. Land surfaces, on the other hand, are poor reflectors; but little insolation is lost in that way; hence more energy is available for raising their temperature. (2) Most of the insolation which enters the water is transmitted to some depth, and, therefore, is not effectively applied to warming the surface. Land is opaque and does not allow the incident insolation to pass beyond a comparatively thin surface stratum; hence this surface can be well warmed. (3) The evaporation of water requires a large amount of energy, which changes the state of the water without raising its temperature (latent heat). Land, although often moist, is itself non-volatile; therefore the loss of energy in the process of evaporation is usually very slight. (4) Water is more difficult to warm than any other natural substance, while land is warmed easily and quickly. If equal amounts of heat are received by equal areas of land and water, the former warms about twice as much as the latter. (5) The mobility of water keeps the warmer and the colder portions well mixed, and therefore greatly retards the process of warming any one portion of the surface. Land cannot thus equalize its temperature. (6) The cloudiness over the oceans is usually greater than over the lands, and this operates to shade the former more than the latter, reducing the energy available for warming the water surface. For these various reasons, ocean surfaces can warm but little during the day, or in summer, and can cool but little during the night or in winter. They, and the air over them, are therefore conservative as regards their temperatures. Land areas, and the air over the lands, on the other hand, warm and cool readily.

Marine or Oceanic Climate.—Conservatism in its temperature conditions is the most distinctive feature of a marine climate. The results of the "Challenger" Expedition show that the diurnal range of air temperature over the ocean between latitudes 0° and 40° averages only 2° or 3°. Further, the slow changes in temperature of the ocean waters involve a retardation in the times of occurrence of the maxima and minima, and a marine climate, there-

fore, has characteristically a cold spring and a warm autumn, the seasonal changes of temperature being but slight. The surface waters of oceans and lakes average somewhat warmer than the air over them, and for this reason all considerable bodies of water which remain unfrozen in winter become sources of warmth for the adjacent lands during the colder months. Characteristic, also, of marine climates is a prevailingly higher relative humidity, a larger amount of cloudiness, and a heavier rainfall than is found over continental interiors. All of these features have their explanation in the abundant evaporation from the ocean surfaces. In the middle latitudes, again, there is this contrast between the oceans and the continental interiors, that the former have distinctly rainy winters, while over the latter the colder months have a minimum of precipitation. Ocean air is cleaner and purer than land air, and ocean air is, on the whole, in more active motion, because friction of air on water is less than friction of air on land.

It is obvious that an equable, damp, and cloudy climate such as that which is, on the whole, typical of the oceans and of their leeward coasts must affect vegetation in a way quite different from that noted in a hotter and drier climate, with greater variations of temperature. Thus Schindler* has shown that wheat contains less protein in a marine climate, and hence more meat, leguminous plants, and other nitrogenous foods are necessarily eaten. An interior climate, like that of Southern Russia and Hungary, produces wheat which is richer in protein: the need of other nitrogenous foods is consequently decreased. The proportion of starch is decreased, and that of gluten is increased, in a hot, dry climate. The size of the crop is also affected by the climate.

Continental Climate.—Marine climate is equable; continental is severe. The annual temperature ranges increase, as a whole, with increasing distance from the oceans;† the regular diurnal ranges are also large, reaching 35° or 40°, and even more, in the arid continental interiors. The warmest and coldest months are usually January and July, the times of maximum and minimum temperatures being less retarded than in the case of marine climates. April is usually warmer than October, unless spring warming is delayed by the melting of a snow-cover. In the latter case, the snow-covered land surface temporarily takes on the charac-

* F. Schindler: *Der Weizen in seinen Beziehungen zum Klima*, Berlin, 1893.

† See chart of equal annual ranges of temperature, Bartholomew's Atlas of Meteorology, Pl. 2.

teristics of a water surface, and has a retarded spring. The greater seasonal contrasts in temperature over the continents than over the oceans are furthered by the less cloudiness over the former. The clearer continental skies of high latitudes favour a lowering of the winter, but a slight rise of the summer temperatures, while in lower latitudes the clearer summer skies favour a higher mean annual temperature. Diurnal and annual changes of nearly all the elements of climate are greater over continents than over oceans; and this holds true of irregular as well as of regular variations. The contrast between marine and continental climates in the matter of the annual march of temperature is shown in the accompanying figure (Fig. 1). In low latitudes the curve for Funchal, on the island of Madeira (M), represents the marine type, and that for Bagdad, in Asia Minor (Bd), the continental. For higher latitudes, the curves for Valentia (V), a coast station in the southwest of Ireland, and for Nertschinsk (N), in eastern Siberia, are representatives of the two types.

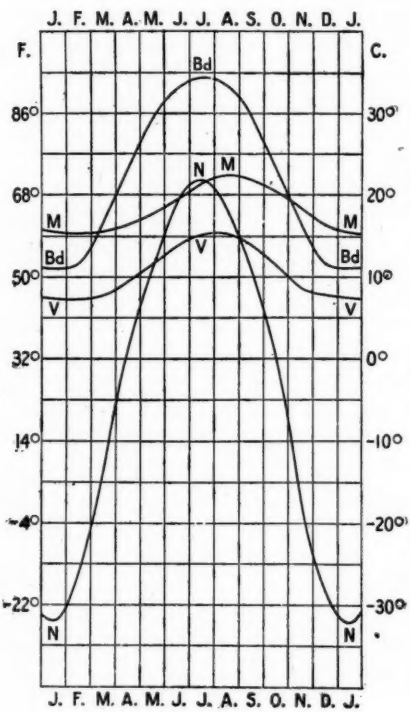

FIG. 1 (AFTER ANGOT).
ANNUAL VARIATION OF TEMPERATURE.

Owing to the distance from the chief source of supply of water-vapour—the oceans—the air over the larger land areas is naturally drier and dustier than that over the oceans. Yet even in the arid continental interiors in summer the absolute vapour content is surprisingly large, although the air is still far from being saturated. In the hottest months the percentages of relative humidity may reach 20% or 30%. At the low temperatures which prevail in the winter of the higher latitudes the absolute humidity is very

low, but, owing to the cold, the air is often damp. Cloudiness, as a rule, decreases inland, reaching its minimum in deserts. And with this lower relative humidity, more abundant sunshine and higher temperature, the evaporating power of a continental climate is much greater than that of the more humid, cloudier, and cooler marine climate. Actual evaporation is, however, under these conditions, usually much less than the possible evaporation which would take place were there enough water present to be evaporated. Both amount and frequency of rainfall, as a rule, decrease inland, but the conditions are very largely controlled by local topography and by the prevailing winds. The decreased frequency of rainfall on the lowlands is especially marked in winter. Winds average somewhat lower in velocity, and calms are more frequent, over continents than over oceans. The seasonal changes of pressure over the former give rise to systems of inflowing and outflowing, so-called continental, winds, sometimes so well developed as to become true monsoons. Usually, however, the changes in direction and the development are not very marked.

In winter, clear, crisp days, followed by cold, calm nights, and interrupted from time to time by spells of cloudy, windy weather, with or without light precipitation; in summer, clear, calm nights, followed by hot days with increasing wind velocity and heavy clouds towards noon, and often by thunderstorms in the later afternoon. These are typical weather conditions of continental interiors in the higher latitudes; and they are of much interest to man. The extreme temperature changes which occur over the continents are the more easily borne because of the dryness of the air; because the minimum temperatures of winter occur when there is little or no wind, and because during the warmer hours of the summer there is the most air movement.

Desert Climate.—An extreme type of continental climate may be found in deserts. It is a curious fact that desert and marine climates—the two extremes of the climatic scale—resemble one another in some respects. Desert air, albeit often dusty by day, is notably free from micro-organisms; the purity of ocean air is well known. Again, deserts and oceans alike have high wind velocities. The large diurnal temperature ranges of inland regions, which are most marked where there is little or no vegetation, give rise to active convectional currents during the warmer hours of the day. Hence high winds, disagreeable because of the dust and sand which they carry, are common by day, while the nights are apt to be calm and relatively cool. Travelling by day is un-

pleasant under such conditions. Diurnal cumulus clouds, often absent because of the excessive dryness of the air, are thus replaced by clouds of blowing dust and sand. This sand, often carried afar, may find a resting-place on the moister lands to leeward. Thus beds of loess are formed. Indeed, many geological phenomena, and special physiographic types of varied kinds, are associated with the peculiar conditions of desert climate.* The excessive diurnal ranges of temperature cause rocks to split and break up. Wind-driven sand erodes and polishes the rocks. When the separate fragments become small enough they, in their turn, are transported by the winds and further eroded by friction during their journey. The ground is often swept clean by the winds. Curious conditions of drainage result from the deficiency in rainfall. Rivers "wither" away, or end in sinks or brackish lakes. Desert plants protect themselves against the attacks of animals by means of thorns, and against evaporation by means of hard surfaces and an absence of leaves. The life of man in the desert is likewise strikingly controlled by the climatic peculiarities of strong sunshine, of heat and of dust.

Coast or Littoral Climate.—Between the pure marine and the pure continental types the coasts furnish almost every grade of transition. Hence coast or littoral climates may well be placed in a group by themselves. Prevailing winds are here important controls. When these blow from the ocean, as on the western coasts of the temperate zones, the climates are more marine in character; but when they are offshore, as on the eastern coasts of these same zones, a somewhat modified type of continental climate prevails, even up to the immediate sea-coast. Hence the former have a much smaller range of temperature; their summers are more moderate and their winters milder; extreme temperatures are very rare; the air is damp; there is much cloud. All these marine features diminish with increasing distance from the ocean especially when there are mountain ranges near the coast, as is the case in the western United States and in Scandinavia. In the tropics, windward coasts are usually well supplied with rainfall, and the temperatures are modified by sea breezes. Leeward coasts in the trade-wind belts offer special conditions. Here the deserts often reach the sea, as on the western coasts of South America, Africa, and Australia. Cold ocean currents, with prevailing winds along rather than on-shore, are here hostile to rainfall, although the lower air is often damp, and fog and cloud are not uncommon.

* See, for example, W. M. Davis: Physical Geography, Boston, 1899, 297–324.

Monsoon Climate.—Exceptions to the general rule of rainier eastern coasts in trade-wind latitudes are found in the monsoon regions, as in India, for example, where the western coast of the peninsula is abundantly watered by the wet southwest monsoon. As monsoons often sweep over large districts, not only coast but interior, a separate group of monsoon climates is desirable. In India there are really three seasons—one cold, during the winter monsoon; one hot, in the transition season; and one wet, during the summer monsoon. Little precipitation occurs in winter, and that chiefly in the northern provinces. The high temperatures of the transition periods are most oppressive when the air is most damp. In India this is the case in the autumn. In low latitudes, monsoon and non-monsoon climates differ but little, for summer monsoons and regular trade winds both give rains, and wind direction has slight effect upon temperature.

The winter monsoon is offshore and the summer monsoon onshore under typical conditions, as in India. But exceptional cases are found where the opposite is true. Thus, on the northwestern coast of Japan, the northeastern coasts of Formosa and of the Philippines, and the eastern coasts of the southern Deccan and of Ceylon, the prevailing offshore winter dry monsoon becomes an onshore rainy wind. Many complicated cases of this kind are not easily co-ordinated. In higher latitudes the seasonal changes of the winds, although not truly monsoonal, involve differences in temperature and in other climatic elements. The eastern coast of the United States has prevailing cold, dry, clear winds from the continental interior in winter, while the prevailing winds of summer are southwest, and hence warm and often moist. The only well-developed monsoons on the coast of the continents of higher latitudes are those of eastern Asia. These are offshore during the winter, giving dry, clear, and cold weather; while the onshore movement in summer gives cool, damp, and cloudy weather. Without these seasonal winds the winters would have the maximum amount of rain and cloud.

Mountain and Plateau Climate.—Both by reason of their actual height and because of their obstructive effects, mountains influence climate similarly in all the zones. Hence mountain and plateau climates are placed in a group by themselves, as distinguished from those of lowlands. The former, as contrasted with the latter, are characterized by a decrease in pressure, temperature, and absolute humidity; an increased intensity of insolation and radiation; larger ranges in soil temperature; usually a greater frequency of, and up to a certain altitude more, precipitation.

At an altitude of 16,000 ft., more or less, pressure is reduced to about one-half of its sea-level value. The highest human habitations are found under these conditions. While the pressures and the pressure changes at sea-level have no marked effect upon man, the physiological effects of the decreased pressure aloft (faintness, nausea, headache, weakness) are experienced by a majority of people at altitudes above 12,000 to 15,000 ft. The symptoms, and the height at which they appear, vary much in different cases,

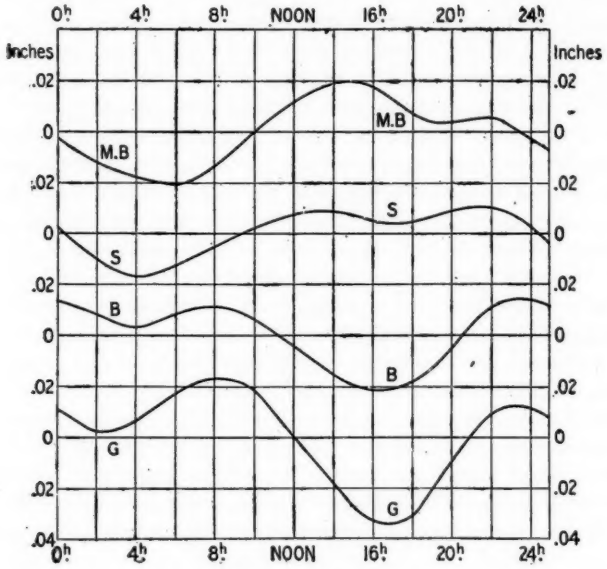

FIG. 2 (AFTER ANGOT).
DIURNAL VARIATION OF PRESSURE.

and depend upon the physical condition, the weather, bodily exertion, and so on. The greatest altitudes attained by man were reached by balloon, and in such cases a supply of oxygen is usually taken up by the aeronaut. Man endures the rapid pressure changes during balloon ascents with difficulty, and often only with considerable suffering. The eagle and the condor, however, suffer no inconvenience during their high flights.

It has been suggested by Jourdanet that mountain and plateau climates be divided into groups, *climats de montagne,* below 6,500 feet, and *climats d'altitude,* above that height. The former are beneficial because of the stimulating quality of their clean, cool

air; the latter may be injurious because of the low pressure. The variations in pressure, as well as the actual pressures, diminish aloft. On high mountains and plateaux the pressure is lower in winter than in summer, owing to the fact that the atmosphere is compressed to lower levels in the winter and is expanded upwards in summer. The morning minimum pressure on mountains is usually the primary minimum, the afternoon minimum being less marked and coming later than on lowlands. Figure 2 shows the diurnal variation of pressure at Geneva (408 meters, G), Berne (573 meters, B), on the Säntis (2,467 meters, S), and on the summit of Mont Blanc (4,811 meters, MB), and illustrates well the general characteristics of the curves found at different altitudes. Local topography, however, is an important controlling influence, and modifies such curves very much.

The intensity of insolation and of radiation both increase aloft in the cleaner, purer, drier, and thinner air of mountain climates. The great intensity of the sun's rays attracts the attention of mountain-climbers at great altitudes. The excess of surface temperature over air temperature also increases aloft, and is a favourable element in plant growth. There is likewise an increase in the range of surface temperature, although this is much influenced by exposure. The vertical decrease of temperature, which is also much affected by local conditions, is especially rapid during the warmer months and hours; mountains are then cooler than lowlands. The inversions of temperature characteristic of the colder months, and of the night, give mountains the advantage of higher temperature then—a fact of importance in connection with the use of mountains as winter resorts. At such times the cold air flows down the mountain sides and collects in the valleys below, being replaced by warmer air aloft. Hence diurnal and annual ranges of temperature on the mountain tops of middle and higher latitudes are lessened, and the climate in this respect resembles a marine condition, but topography and the conditions of local clouds and winds are here important controls. The times of occurrence of the maximum and minimum are also much influenced by local conditions. Fig. 3 shows the diurnal march of temperature for Paris (solid) and the Eiffel Tower (broken) in January and July. It will be noted that the times of maximum and minimum are retarded on the Eiffel Tower, and that the range is less than at the earth's surface. These are characteristics of mountain climates. Elevated enclosed valleys, with strong sunshine, often resemble continental conditions of large temperature range, and plateaux,

as compared with mountains at the same altitude, have relatively higher temperatures and larger temperature ranges. Altitude tempers the heat of the low latitudes. High mountain peaks, even on the equator, can remain snow-covered the year around; the plateau of southern India at 6,000 to 7,000 ft. above sea-level always has moderate mean temperatures, and from the dense

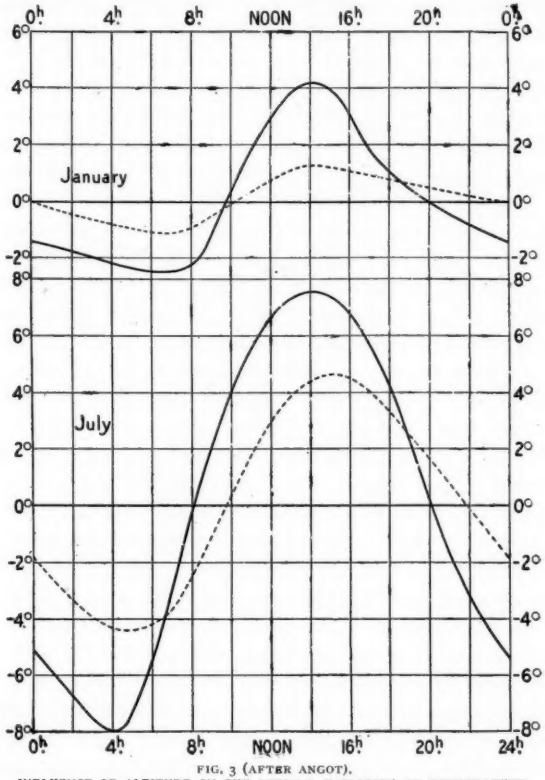

FIG. 3 (AFTER ANGOT).
INFLUENCE OF ALTITUDE ON THE DIURNAL VARIATION OF TEMPERATURE.

jungle of the tropical lowland to the snowy mountain-top successive zones of vegetation are encountered.

Nine-tenths of the water vapour in the atmosphere are below 21,000 feet. Hence mountains are important vapour barriers, and one side may be damp while the other is dry. Curiously mistaken ideas of distance often result from the remarkable clearness and dryness of the air on high mountains. No general law governs

the variations of relative humidity with altitude, but on the mountains of Europe the winter is the driest season, and the summer the dampest. At well-exposed stations there is a rapid increase in the vapour content soon after noon, especially in summer. The same is true of cloudiness, which is often greater on mountains than at lower levels, and is usually at a maximum in summer, while the opposite is true of the lowlands in the temperate latitudes. One of the great advantages of the higher Alpine valleys in winter is their small amount of cloud. This, combined with their low wind velocity and strong insolation, makes them desirable winter health resorts. Latitude, altitude, topography, and winds are determining factors in controlling the cloudiness on mountains. In intermediate latitudes there is a seasonal migration of the level of maximum cloudiness and of maximum relative humidity from the lowlands in winter to higher altitudes in the warmer months, in association with the diurnal convectional movements of the warmer season. Frequent rapid local changes also occur. In the rare, often dry, air of mountains and plateaux evaporation is rapid, the skin dries and cracks, and thirst is increased.

Rainfall usually increases with increasing altitude up to a certain point, beyond which, owing to the loss of water vapour, this increase stops. The zone of maximum rainfall averages about 6,000 to 7,000 feet in altitude, more or less, in intermediate latitudes, being lower in winter and higher in summer. Mountains usually have a rainy and a drier side; the contrast between the two is greatest when a prevailing damp wind crosses the mountain, or when one slope faces seaward and the other landward. When the prevailing winds differ little in dampness this contrast is lessened, and there may then be a very close correspondence between the rainfall and the topographic map of a region. Mountains often provoke rainfall, and local "islands," or, better, "lakes," of heavier precipitation result. Such are found on the mountains of the Sahara, and of other deserts. This local precipitation favours the growth of vegetation; small streams and oases are found, and temporary camps, or more permanent settlements, of the nomadic tribes of the desert, are there established. Well-marked zones of vegetation are noted under such conditions, as in the transition from the dry Californian lowlands up through the deciduous and then the coniferous forests of the Sierra Nevada to the snows on the summits. Similarly, the high plateaux of southern Utah and of Arizona are high enough to receive fairly abundant rainfall, while the lowlands are arid.

Mountains resemble marine climates in having higher wind velocities than continental lowlands; mountain summits have a nocturnal maximum of wind velocity, while plateaux usually have a diurnal maximum. Mountains both modify the general, and give rise to local, winds. Among the latter the well-known mountain and valley winds are often of considerable hygienic importance in their control of the diurnal period of humidity, cloudiness, and rainfall, the ascending wind of daytime tending to give clouds and rain aloft, while the opposite conditions prevail at night. The high temperature and dryness of the *foehn,* which is of immense benefit to man by reason of its melting and evaporating powers, although often enervating and depressing, result from the fact of a descent of the air from a mountain slope or summit. The bora, with its cold gusts, is a wind in whose development a mountain or plateau is essential. And the mistral of Southern France owes some of its cold to radiation over the interior plateaux.

Mountains as Climatic Divides.—Very different conditions of temperature, pressure, and humidity may be found on the opposite sides of a well-defined mountain range, because such a range interferes with the free horizontal interchange of the lower air. Mountain ranges which trend east and west, like the Alps and the Himalayas, separate more severe from less severe climates; those which follow a coast-line, as in the case of California, Scandinavia, or eastern Siberia, separate marine from continental. Large differences of pressure on the two sides may be equalized by a flow of air across the mountain, as in the foehn.

AMONG THE MOUNTAINS OF SHEN-SI.

BY

BAILEY WILLIS.

In the province of the Western Passes, Shen-si, among the outliers of the Tibetan Mountains, six hundred miles southwest of Peking, spreads a rich valley. The Wei River flows through it from west to east, and the Huang-ho, entering it from the north, turns sharply eastward and leaves it by a cañon which leads to the great plains. In extent this valley of the Wei is not unlike that of the Mohawk in northern New York, or that of the upper Danube in southern Germany. It is a wide and fertile plain,

shut in among mountains, but through it pass the great highways of the continent, and it has been the scene of historic events, the centre of dynasties, for more than three thousand years. Southeast of this valley rises the Hua-shan, a granite range whose bold cliffs compare with those of the Yosemite. Their grandeur is enhanced by contrast with the level plain, the base from which they tower abruptly without intervening slopes. The Hua-shan is one of the five sacred mountains of China, and on its summit, four thousand feet above the plain, are monasteries, which are reached by means of irons and chains set in the rocks. Westward from its highest point the crest of the range declines, the face becomes less precipitous, and the ridge sinks at length beneath the valley plain. The traveller who rounds it sees to the south another great mountain chain, the Ts'in-ling-shan, which stretches westward as far as the eye can reach and ultimately merges in the High Plateaux of Central Asia. It has been called the Barrier Range of China; for, as the Alps divide Germany and Italy, so the Ts'in-ling-shan separates North China from South. Among the many more or less difficult paths by which it may be crossed by mountaineers there is but one pass which Nature has opened across it. Toward its eastern end, where it becomes tangent to the southern slope of the Hua-shan, only a low divide separates a tributary of the Wei River from the T'ang-ho, a tributary of the Han and the Yang-tze, and through this pass lies one of the great historic routes of migration and commerce, from the plains of southeastern China to central Asia and Europe. A second highway passes the eastern end of the Hua-shan. It is that which leads southwest from Peking, through Shan-si into the valley of the Wei, and which continues thence southwestward across the Ts'in-ling-shan to the rich province of Sze-chwan, the upper Yang-tze, and India. The passage of the barrier range is accomplished by a military road said to have been laid out by the Emperor Ts'in, the builder of the Great Wall, 255-206 B. C. In the later history of the rise and fall of Chinese dynasties it was long neglected and but partly rebuilt. Though it excited the astonishment of the Tyrolean Father Martini, in the middle of the seventeenth century, it had sunk in von Richthofen's day, 1880, to the condition of a wretched mule path, scarcely practicable for pack animals.

At the foot of the mountains where the roads meet from the Yang-tze, from Peking, from Tibet, and from India is a great commercial city, Si-ngan-fu. Its history is rooted in the myths of the earliest Chinese traditions. Eleven hundred years before Christ it

HUA-SHAN,

IN THE PROVINCE OF SHEN-SI. ONE OF THE FIVE SACRED MOUNTAINS OF CHINA, AS SEEN FROM THE VALLEY OF THE WEI.

was the capital of the Chou dynasty, and for many centuries it continued to be an imperial city. It was the most eastern point known to Ptolemy, the geographer, and by Marco Polo was described thus:

> And when you have travelled those eight days' journey, you come to that great city which I mentioned, called Kenjanfu. A very great and fine city it is, and the capitol of the kingdom of Kenjanfu, which, in the old times, was a noble, rich and powerful realm, and had many great and wealthy and puissant kings. But now the king thereof is a prince called Mangalai, the son of the Great Kaan, who hath given him this realm, and crowned him king thereof. It is a city of great trade and industry. They have great abundance of silk, from which they weave clothes of silk and gold of divers kinds, and they also manufacture all sorts of equipments for an army. They have every necessary of man's life very cheap. The city lies towards the west; the people are Idolators; and outside the city is the palace of the Prince Mangalai, crowned king, and son of the great Kaan, as I told you before.

In recent times the old city, long deserted by royalty, once more became the imperial residence. The Empress, when she fled from Peking, took up her abode there, ostensibly to do honour to the ancient emperors, but in fact to get as far as possible from the invading barbarians. To-day the city has returned to those pursuits of commerce which its geographic position naturally determines, and the people are happier than when the hordes of hangers-on of the Court devoured their substance and the price of food became exorbitant even in the fertile valley of the Wei. The road from Peking to Si-ngan-fu was prepared for the royal progress by grading away ruts and covering the surface with yellow earth; all traffic was suspended for two weeks, and the communities and carters suffered accordingly. One still heard mutterings against the Empress for having the people's interest so little at heart when, three years later, I followed the route of her flight.

The people along the road still cursed the Empress when I passed that way four years later. Coming from the direction of Peking, the historic highway crosses the Yellow River at the Tung-kuan, a fortress of strategic importance in the T'ai-ping rebellion and earlier wars, but now easily within reach of artillery from the high terrace north of the river. Thence it passes beneath the lofty crags of the Hua-shan and, a few miles from Si-ngan-fu, reaches the hot springs of Lin-tung. A journey of three weeks in Chinese carts, through the loess country of Shan-si, prepares the traveller for rest and the rare pleasure of a bath. The impalpable yellow dust of the roads through the loess penetrates every garment and the very pores of the skin, and one who has not experienced it can scarcely imagine the choking sensation with which you ride hour after hour in its yellow cloud. I had sent our Chinese boys ahead, and expected, on arriving at Lin-tung, to find comfortable quarters ready for our

reception; but instead, our loaded carts stood outside the enclosure about the springs, and Li, our head boy, was engaged in angry altercation with the servants in charge of the Kung-kuan, the official hostelry. Stick in hand, the loyal but excitable fellow was ready to lay about him with a will, when I appeared. He was insulted in our behalf at the wretched pools in which they suggested we might bathe, and which were commonly used by coolies. I was angered, too; but firmness and dignity go farther in China than threats or blows, and by their use we soon opened the doors to the official apartments. There were airy reception-rooms looking out upon a pleasant court, and private rooms adjoining, in each of which was a deep square tank of stone filled with an overflowing current of hot water, 104° Fahr., into which a flight of steps led down. Close by were the garden, pavilion, and bath used by the Empress during her residence at Si-ngan-fu. The bushes were growing over the paths, and the buildings, stripped of their hangings and furniture, were desolate; but pacing the terrace before the Empress' private apartment, looking down upon the pretty pavilion on an island in the bubbling pool, or out across the walls to the expanse of plain and lofty mountains, one pondered what influences had wrought upon the remarkable woman who, returned to Peking, has reversed her whole course of action, and now welcomes the aliens from whom she once fled. Her course presents, in the full glare of publicity, a change of front such as the Chinese not infrequently execute when necessity commands—and execute, too, with a grace which converts the necessity into a voluntary purpose.

Si-ngan-fu is the residence of the Governor of Shen-si, and our reception was for us a matter of importance, as likely to indicate the attitude of that official toward the surveys we wished to prosecute. Passports and letters of introduction had preceded us, and we had every reason to expect that courtesy which had been extended to us elsewhere; but though we had travelled several days in the province, no message of greeting had come from the Governor, and his subordinates, the magistrates residing in the chief towns along the way, had no instructions concerning our party. On leaving Shan-si we had rewarded and dismissed the four faithful cavalrymen who, by order of the Governor of that province, had accompanied us three hundred miles on our journey, and we were now travelling unattended toward the city. The great road crosses a tributary of the Wei, on a fine stone bridge a quarter of a mile in length, and one sees the massive walls of the city, fifty feet high, with crenelated battlements and huge gate towers, rising

from the higher plain. Along the highway outside the wall, for something more than two miles, stretches a densely-built suburb of shops and dwellings, many enterprising merchants having establishments outside the gate to avoid the city tax on produce and goods which pass in. We approached from the north, and rode in carts slowly through the busy throngs of the suburbs, along one of the two principal streets which cross at right angles in a central tower, a heavy structure with four arches covering the intersecting streets. There the congested traffic is forced into still narrower space, in which there is scarcely room for two carts to pass, and yet on either hand vendors of trifles and eatables establish their stands, and coolies, eating bowls of rice or soup, sit unmoved, though the long projecting axles graze their backs. Here one may see every grade of Chinese society, from the beggars who sit before shop doors picking vermin from their rags till paid to move on, to the high official who comes in his sedan chair, preceded by horsemen and footmen and the blare of trumpets. All outside official rank jostle elbows in the crowd—the labourer, the hawker of trifles, the banker, and the scholar. And the labourer's son, as well as the banker's or the scholar's, if he have ability and learn, may come to ride in his chair with banners and trumpets going before him.

There being no one to direct us to the quarters usually provided by official courtesy, we pressed through the moving throng to an inn, the only one available—a dark, noisome place reeking with filth. Our cards were sent to the Foreign Office, and then ensued an exchange of profound regrets—regrets on the part of the official whose duty it was to receive us that the city was so wretchedly poor there was no suitable place to entertain such distinguished visitors; regrets on my part that so eminent and learned a man as he must be should so disgrace himself by allowing strangers to remain in lodgings so unfit. After two days of courteous but unwavering insistence, we were recognized and were given decent accommodations. Interviews with the officials, military and civil, including the Governor, followed, and the obstacles which had threatened to stop our further explorations vanished. We found the Governor, if not progressive, intelligent and friendly; and let me say that he was justified, unfortunately, in receiving foreigners with suspicion. Some months before there had come one, a traveller from Europe through central Asia, whom we had to thank for our reception here as well as for that at the hot springs of Lin-tung. With vile language and brutal temper

he had demanded everything, paid for nothing, and beaten the servants sent to attend him. True, he was an uncommon brute; but there are too many of his kind. The Chinese gentleman is not without reason in seeking to assure himself that the foreigner is not "ignorant of restraint."

From Si-ngan-fu our route lay southward across the Ts'in-ling-shan to the Han River. We did not wish to tread the well-known routes of the great highways; we asked about by-ways, and prepared to abandon the comfort of Chinese inns for tents in the wilderness. The many coolies required to carry food made a striking procession as they straggled out from Chou-ch'ih-hien, the town in which we assembled the outfit for our start. The day was showery, and the men went bare-legged, shod with grass sandals, their blue blouses tucked up and their huge umbrella-like hats tied under their chins. Spring had come in the valley of the Wei. Wheat and poppy fields were green, violets and lupine blossomed, the trees were opening their buds, and the scent of moist earth filled the air. Heavy clouds still hid the Ts'in-ling-shan after three weeks of rain, and the mountain streams were foaming torrents.

We could learn but little concerning the route ahead, and were warned not to attempt the mountain paths and fords; so, leaving my two American comrades and the coolie caravan to work their way slowly into the defiles of the northern front, I pressed ahead with Li and a single mountaineer, to reconnoitre. It is well said in China you cannot get out of sight of the Chinese; even in the Ts'in-ling-shan they inhabit every nook, and footpaths lead everywhere. Wild, rough trails they are, unfit for even donkeys; constantly crossing and recrossing the torrential streams, occasionally carried around a cliff along poles or boards, supported on rotting props stuck in the rocks. The mountain face rises abruptly, the cañons are deep and narrow from their mouths inwards, and soon the steep and jagged spurs shut out all view but the rocks, the foliage, and the clear, brawling river. Along the footpath is here and there a hut, and one meets the poorest of the poor carrying out heavy loads of coffin boards. Sawed out where the tree grows, these are about three inches thick, eight feet long, and a foot to eighteen inches wide. Four of them, slung on a man's back so that one end rests on the ground when he stands upright, but is raised from it as he bends forward, make a staggering load. Steadying himself by two poles shod with iron the bearer crawls slowly along the dangerous path. Glancing up as they met me,

these men looked dumb amazement; they were too slow to catch a passing remark, but where I stopped among them they were quiet and obliging. Sometimes I slept outside their huts, in the shelter of a boulder or cliff. One night I was housed in an inn which they frequented. There was a big room, where the kang, the clay sleeping platform, was heated for all comers to share; the one great cast-iron bowl served to boil whatever any one brought, and the smoke, steam, and human reek were breathed by all alike. I stayed in it long enough to get a distinct impression of the Devil's reception-room in Hades, and was glad of a corner in a storeroom, which Li had found and made comfortable.

The first foreigner to tread that trail, I was an object of intense curiosity; but I was not annoyed. Children came to stare and stayed to be amused; the older ones of the family passed through oftener, perhaps, than their avocations required, but the vulgar impertinence of village crowds was not apparent. The innkeeper's wife came and went about her business. She was shabbily dressed, but wore silver earrings, two finger rings, and a bracelet. From the bag of flour she weighed out portions with a steelyard and basket that she balanced accurately. All food is carried in, and flour costs fifty cash a catty, as against twenty-eight in the plains below. The villagers are woodcutters; they drive logs on the stream with spiked poles, much as we do, but their logs are rarely more than a foot through and eight feet long. There are two distinct ethnological types among these people. The one is of pale yellow complexion, with well-developed nose and straight eyes; the cheek-bones are high and the jaws slender. It is a type we see in north China, where the slanting almond eye of the southern Chinese is not the rule. The other face is very broad and flat, the eyes set in long straight slits and far apart; where the bridge of the nose should be is a hollow, and the wide nostrils expand under a turned-up tip of a nose. The mouth is very large, the expression dull but very good-natured. Both men and women are remarkably short, but very broad and strong. I took the latter type to be survivors of an aboriginal race, or remnants of a distinct immigration, which elsewhere has been absorbed by the dominant Chinese.

After several days' absence, I returned from the summit of the Ts'in-ling-shan to my comrades, who had made their way up the cañon of the Hei-shui-ho. The reconnoissance having made it evident that we must carry more food and be prepared for greater delays than we had anticipated, Li was sent out with

fifteen coolies to bring in rice. Before he could return the Hei-shui-ho was swollen by continuous rains to a flood which cut us off in all directions, so we prepared to wait as patiently as we might for Li's return, and were astonished when he appeared early one morning with his heavily-loaded men. After trying the fords and finding them impassable, he had built a raft; and having put the rice upon it, he and the coolies had swum the river, pushing it before them. They thus reached a dangerous track, which had once been a pathway on the eastern bank but was washed out and abandoned, and along this they made their way to us.

From our camp on the Hei-shui-ho the path led up from the cañon to gently-moulded spurs of the still higher mountain summits, presenting a contrast such as may be seen in North Carolina, in Norway, and many other mountain districts where an old hill country has been rapidly uplifted to mountainous altitude and sharply and deeply cut by the rivers. The heights had once been timbered; and though the climate above 5,000 feet is severe, they had been to some extent cultivated while lumbering flourished. Then our route was frequented by merchants, and the inns did a profitable business; but in those days life was not any too secure in these remote fastnesses. If a lonely traveller was seen to have money, he was made away with at one inn or the next, the landlords being leagued together, and his body was easily disposed of. One wonders why, with the cañon close at hand, the victims should have been buried; yet we were shown a pit near one of the houses in which it was said a large number of skeletons had been found, when justice finally overtook the murderers.

At the little village of Siau-wön-kien we found thirty or forty people remaining from a population that had once numbered several hundred. Abandoned houses and stores were in ruins, and a richly-painted idol of Kwang-shöng-ti, the protector of the people, continued to gaze fiercely but helplessly on a scene of destitution. The wealth of the place had vanished with the utter destruction of the forest. A disease had attacked the potatoes, the oats had failed, and wild hogs, appearing in droves, had become a pest against which the farmers could not protect themselves. In one case we saw fields freshly uprooted, and near-by was a newly-abandoned house. And yet here, in this poverty-stricken community, a gift was volunteered by the head man; a basketful of potatoes and walnuts, a white chicken, a little maccaroni, and some oat flour. He came accompanied by two or three friends, and talked with us a few moments—his first interview with foreigners.

I was at a loss for an equivalent gift, our supply being low and not well suited to the villagers' needs, but I bethought me of the generous outfit of thread, needles, and pins which had been provided for my own use. Four needles, two rows of pins, two safety-pins, eight hooks and eyes, a spool of cotton, and a cake of chocolate made up the return gift. Li told me it gave much pleasure, most of the articles being the first of their kind the people had seen. Needles they had, coarse Chinese ones, but not such cotton thread—so strong, so smooth.

Approaching Siau-wön-kien, the route taken by our coolies again led through a gorge and often crossed the flooded river. One of the bearers, an old man, was swept away by the stream and roughly handled among the boulders before he was rescued. It was reported that he was drowned, but he was presently brought to meet me as I hastened to see what might be done for him. Trembling with fear, his ragged clothes clinging to him, the poor old fellow threw himself on hands and knees before me and struck his forehead on the ground. He was imploring pardon for having wet his pack! I raised him and again he prostrated himself. Then one of the boys told him to stand up, and he stood, but shivering from chill and nervous shock. We poured him hot brandy and water, which he drank eagerly; then one of our T'ients'in boys, whose good heart we had more than once had occasion to recognize, took the old man into a room, rubbed him down hard, and lent him dry clothes. Later I called my boy: "Sha-ehr-ko!" Yees, sir." "How old man?" "Old man very hot, sir; very hot."

From Siau-wön-kien to the foot of the pass, a distance of twelve miles, we were told to expect forty fords; and we certainly realized them, though the flood had somewhat run down before we attempted them. In its upper stretches the river had become a jolly, rollicking, boisterous stream, with many rapids and falls over ledges of hard rock, which also form bolder cliffs than the banks of slate farther down. By many of the fords a little shrine was built in the cliff, and within were grotesque dolls, idols to which the mountaineers pray before trying to cross. As offerings to the spirit of the place they also place on end, on convenient ledges above the stream, long stones, simply picked up in the shingle. This custom, which was evidently much practised, has its origin in India.

We crossed the range at a pass marked by the ruins of an old temple called the Wön-kung-miau, and at an elevation of only 7,700 feet. The highest summit near-by was 9,700—a broad-

SUMMITS OF THE TS'IN-LING-SHAN, THE BARRIER RANGE OF CHINA, LOOKING SOUTH TO THE MAIN DIVIDE. HEIGHTS, 8,000 TO 10,000 FEET.

shouldered, massive mountain, and the general altitude of the hills on many ridges reaching far to the northeast and south was about 8,500 feet. Thirty miles to the southwest the Ta-pai-shan, a range marked on many European maps, towered to 11,500 feet, and in the latter part of April was still covered with snow, which probably does not altogether disappear during the summer. The Ts'in-ling-shan is thus not a sharply-defined mountain chain, but a broad, even-topped uplift, carved by streams which flow in their principal courses north or south, with only a subordinate development of east-west valleys parallel to the range and the structure of the rocks. The northward-flowing streams fall 6,000 feet in thirty miles, to the valley of the Wei; those which flow southward have no greater total fall in seventy miles, to the valley of the Han. The northern spurs have a cold winter, wet spring, and short summer; the southern slopes lie in a mild, temperate climate and descend to a semi-tropical one. Near the divide are extensive forests of pine, spruce, and hemlock, mingled curiously, even up to 7,000 feet above sea, with thickets of bamboo. Thence we passed down through the zones—from where the snow still lay in sheltered nooks and trees were scarcely in bud to where cherries were ripe and palms stood among the luxuriant growth of early summer. We passed the lilac and rhododendron and a large purple columbine. Where the rhododendron reached its lowest limit, at 3,500 feet above sea, were the highest of the rice fields, which are terraced into every nook of the mountain side that can be irrigated. This is the natural home of the Wichuraiana rose. It hangs in festoons over trees and cliffs, and in the higher zone just coming into blossom it bore on each graceful drooping branch hundreds of pink-white buds. Thence for sixty miles it was rarely wanting and bloomed with wonderful profusion. One vine had a stem ten inches in diameter, and completely covered, as with a veil of white lace, a tall wide-spreading tree. Single sprays hung from high branches almost to the ground, bearing quantities of blossoms and swinging with upturned ruddy tips in the breeze. Less graceful, yet charming in their way, were two mimosas, the one pale lavender, the other gorgeous yellow, and lupines and pea vines covering whole fields. But among flowers of field or mountain side none vie with the poppy, the native's pleasure and his profit. It blossomed white as a lily and red as a jacqueminot, but often, also, of that sombre sang-de-bœuf hue, the shadow tone of rosy lights, which fittingly suggests the gloom into which the Chinese are drifting with phantoms

of the opium dream. We first saw it unfolding its curling, scimetar-like leaves in the chilly upper air; then we passed on every hand its gorgeous nodding flowers; and lower down, their work done, the petals were falling and the pale green serpent's head stood up naked, not ugly in itself, but hideous in its potency of evil.

In the valley of the Pu-ho there was a well-established foot-path, suitable even for pack animals, and our difficulties were over when we crossed the summit. The way was easy to the Han River, which we reached at the walled city of Shï-chuan-hien, one hundred and ten miles from Chou-chlï-hien. We had crossed in twenty days, at a most unfavourable season, with many delays occasioned by weather and high water. Nowhere had we met with any real difficulty, and, judging by the accounts given by von Richthofen and others of the cañons through which the great southwestern highway between the Wei valley and Sze-chwan is built, the route which it takes offers much more formidable obstacles to the passage of the range than any we encountered. The pass we crossed and the approaches to it are entirely practicable for railway construction, and it is quite possible that still better ways might be found. The rocks above the active work of running streams are somewhat decayed and often soil-covered, yet firm underneath. When, in the development of the Chinese Empire, it becomes necessary to connect the valley of the Wei with that of the upper Han River at Han-chung-fu, there will be no difficulty in building that section of the great southwestern trunk line, even across the barriers of the Ts'in-ling-shan.

CERTAIN RELATIONS OF RAINFALL AND TEMPERATURE TO TREE GROWTH.

BY

HENRY GANNETT.

Of the various factors, climatic and otherwise, which affect the growth of forests and different species of trees, there are two which are of a primary character. These are annual temperature and annual rainfall—that is, the amount of heat and the amount of water. These two factors determine whether trees can grow, and if so, what species.

There are numerous other factors which have a modifying effect, among which are seasonal temperatures, seasonal rainfall,

humidity of the air, evaporation, wind exposure, slope exposure, degree of slope, and soil texture and depth.

The roots of trees penetrate into the soil to such a depth that they are not affected by ordinary droughts. Whether a season is dry or wet matters little so long as the year's precipitation is sufficient. Trees are hardy plants, as a rule, and are not affected by short periods of extreme heat and cold. Hence, seasonal variations, either of rainfall or temperature, have little effect upon them. That this is true in regard to rainfall is shown by the fact that yellow pine flourishes upon the slopes of the Sierra, where most of the rain comes in the winter, and also upon the Colorado plateau in Arizona, where most of it comes in the summer.

Exposure to wind has, of course, a modifying influence in the distribution of trees, especially on high mountains; but it is not a determining factor. The timber-line is not caused by wind; if it were, trees would extend to the summits of the highest mountains on the leeward side. As it is, the effect of wind and of depth of soil is shown in the elevation or depression of the timber-line for a few hundred feet only.

Near the lower limit of the yellow pine in the Sierra Nevada this tree is seen to extend farther down upon the north slopes of the spurs, and in damp, sheltered places; but the effect of such slope exposure is seen for two hundred, or possibly three hundred, feet only, while the absolute disappearance of yellow pine at certain altitudes in the Sierra is due to some other cause, and certainly not to this or any of the causes above enumerated as secondary. The fact that this line coincides very closely from the north to the south limit of the United States with the isohyetal line of 20 inches is pretty good evidence that it is annual rainfall that induces it, whatever local variations may be introduced by secondary causes.

The fact that under the same rainfall and other conditions different species are found in tropical, temperate, and polar regions is evidence that the annual temperature is the determining factor in such cases.

If the foregoing is conceded, it would seem that the following is the logical order of entering upon the study of the relations of climatic and other conditions to the growth and distribution of trees:

1. The influence of the primary causes as above stated.
2. The modifying influences of the secondary causes.

The present paper is designed to show how much and what

information our present knowledge of the climatic elements develops concerning tree growth in the western United States. The fact that in the matter of temperature only negative results have thus far been reached shows, to my mind, only the imperfections of our knowledge—imperfections which will be remedied by more extended and better-directed observation. In the matter of rainfall it seems to me that certain facts of importance have been developed—that is, the rainfall at the lower limits of forests in general, and of yellow pine, red fir, and redwood.

For several years past the United States Geological Survey and the Forestry Bureau of the Department of Agriculture have been employed in collecting information concerning the distribution of forests in the mountain regions of the West. The former organization has for the past ten years been engaged in the examination of forest reserves and adjacent lands, and in the preparation of land-classification maps of these areas. Furthermore, the topographers of the Survey working in this part of the country have, in addition to the preparation of topographic maps, prepared also land-classification maps.

The Forestry Bureau has in recent years made examinations and prepared reconnoissance maps of large areas which had been withdrawn from settlement with a view to creating forest reserves.

The work of these two organizations taken together covers nearly all the forested land of the West and makes it possible to prepare a map of this part of the country showing the regions which are wooded or forested and the areas occupied by certain kinds of timber.

The distribution of timber generally and of the species above designated, with relation to the two chief elements of climate—temperature and moisture—is a matter of great interest. Knowledge of the limiting temperatures and limiting rainfalls within which timber in general will grow, and within which different species of timber will grow is of first importance in the study of forest environment.

The information concerning climatic elements has been obtained from the Weather Bureau, whose officers have placed at my disposal not only all printed data concerning temperature and rainfall, but all manuscript material in their possession. There are returns from probably one thousand meteorological stations scattered over the Rocky Mountain and Pacific Coast States. After discarding all stations in which the rainfall series is less than five years, I have the records of a little over four hundred stations.

Most of these stations present also a record of temperature, so that the temperature stations are between three and four hundred in number. The distribution of these stations is not, however, by any means what could be desired, the great majority of them being situated in towns and cities, and therefore in low and open or non-timbered country; and very few of them are high up in the mountains, so that in those parts of the West in which the timber is confined to the mountains the timbered regions are not well represented. This is especially true of the Rocky Mountain States, including Montana, Idaho, Wyoming, Utah, Nevada, Colorado, New Mexico, and Arizona. In these States nearly nine-tenths of the stations are in open country, only a few more than one-tenth being situated in the forests. In western Oregon and Washington, where the forests cover the valley lands as well as the mountains, there are naturally many stations in the forests. To a less extent this is true of northern California, but in southern California it is much the same as in the Rocky Mountain States. Hence it is that the information concerning the temperature and rainfall of the forested region in the Rocky Mountain States and southern California is scanty, while in northern California, western Oregon, and Washington it is much more abundant.

The mean annual temperature at any place is fairly constant year by year—that is, the mean temperature of one year differs but little from that of other years; hence it does not require a long period of observation to establish accurately the mean annual temperature at any locality. Moreover, the temperature is not much affected by topographic surroundings, so that the observations made at any place fairly represent the temperature of the neighbouring country. This is not, however, the case with rainfall observations. The surrounding topography, and even the location of the rain-gauge, materially affect the amount of rainfall and the amount of water collected, so that there is no assurance that the rainfall measured at the station represents the rainfall of any considerable area surrounding it. Further, the rainfall of different years differs widely. In a locality twice as much rain may fall in one year as in the year preceding or the year following, and it is only by obtaining the mean of a series of years that one is assured that he has the average rainfall of his station. It is owing to these uncertainties that one must use rainfall measurements with caution and should obtain the mean rainfall of a group of stations as that of a locality, rather than one station alone.

The figures for rainfall and temperature at all of the stations obtained were platted upon Land Office maps of the several States, and the outlines of timber sketched upon the same maps or upon different maps. In this way the location of the different stations was obtained with reference to the forests.

In this study the lands were first classified as *open* or *timbered.* The timbered lands were classified as *yellow pine, red fir, redwood lands,* and *"other timber."* In "other timber" are included lands covered with piñon, juniper, nut pine, and oak, which may be grouped under the designation "desert species."

The stations in each of these classes were taken off the map, with their rainfall and temperature. The average rainfall and temperature of each of these classes of lands was obtained from the figures. The stations were also grouped in each of these classes, the groups being for the temperature each five degrees and for the rainfall each ten inches. The results are set forth in tables:

TEMPERATURE.

States.	Average Temperature in Degrees Fahr.				
	Yellow Pine.	Fir.	Redwood.	Desert Species.	Open Country.
Arizona	54	..	..	62	65
Colorado	..	..	..	..	47
California (North)	51	..	54	61	60
California (South)	..	..	..	57	63
Idaho	..	..	..	..	48
Montana	44	..	..	..	43
New Mexico	..	..	..	52	56
Nevada	..	..	..	.	50
Oregon	50	51	..	..	47
Utah	..	..	..	.	49
Washington	46	50	..	..	48
Wyoming	..	..	..	..	42
Average temperatures of total stations	50	51	54	60	54

RED FIR.

Number of Stations in each Temperature Group.

States.	40°-45°	45°-50°	50°-55°	55°-60°
Washington	..	4	21	1
Oregon	1	..	22	..
Totals	1	4	43	1

OPEN COUNTRY.

NUMBER OF STATIONS IN EACH TEMPERATURE GROUP.

STATES.	35°–40°	40°–45°	45°–50°	50°–55°	55°–60°	60°–65°	65°–70°	70°–75°	75°–80°
Colorado	2	8	16	14	..	..	..	..	..
Arizona	.	..	1	3	..	12	9	8	..
Washington	..	1	8	5	..	..	..	..	..
Wyoming	3	11	7		..	..	..	..	..
Idaho	1	3	4	6	1	..	..	..	..
Montana	1	12	4	..	..	..	..	..	..
New Mexico	..	..	2	3	5	3	1	..	..
Nevada	1	..	9	10	3	.	..	..	..
Oregon	..	1	6	2	..	..	..	..	..
Utah	1	1	14	14	1	..	..	..	..
California (South)	..	..	..	1	21	20	10	3	4
California (North)	..	..	1	8	13	30	7	..	..
Totals	9	37	72	66	44	65	27	11	4

YELLOW PINE.

NUMBER OF STATIONS IN EACH TEMPERATURE GROUP.

STATES.	40°–45°	45°–50°	50°–55°	55°–60°	60°–65°
Arizona	..	1	..	.	1
Washington	2	4	1	..	..
Oregon	1	1	7	..	..
California (North)	5	2	12	3	3
Totals	8	8	20	3	4

DESERT SPECIES.

NUMBER OF STATIONS IN EACH TEMPERATURE GROUP.

STATES.	45°–50°	50°–55°	55°–60°	60°–65°
New Mexico	..	2	..	..
Arizona	..	..	..	1
California (North)	..	..	5	18
California (South)	1	..	6	..
Totals	1	2	11	19

RED WOOD.

NUMBER OF STATIONS IN EACH TEMPERATURE GROUP.

STATE.	50°-55°	55°-60°
California	3	3

The table showing the average temperature of different classes of country is apparently of little significance, partly because of the irregular distribution of the stations, especially in certain of the timbered regions, and partly because there does not appear to be any characteristic difference of temperature in different regions. Because of the first of the above qualifications it is probable that the average temperature of the yellow-pine regions is too high, since most of the stations within this region are in the lower part of the timber-belt. The distribution of stations in the red-fir region is fairly uniform, and the temperature given in the table is probably not far from correct. The same is probably the case with the redwood region. Under the heading of "Open Country" are included the great plains, broad valleys, and desert regions generally, and the temperature of these regions differs widely in different parts of the country, from 42 degrees in Wyoming up to 65 degrees in the deserts of Arizona, and the average has little significance.

Classifying these stations in groups of five degrees of temperature each, it is seen that in the open country no less than 93 per cent. of the stations are found where the temperature ranges between 40 and 70 degrees. In the States of Wyoming and Montana there was no station with a temperature exceeding 50 degrees. In Colorado, Washington, and Oregon there was no station exceeding 55 degrees. On the other hand, in southern California stations are found ranging up nearly to 80 degrees, while there were none below 50 degrees.

The table relating to yellow pine shows that the greatest number of stations is found where the temperature is between 50 and 55 degrees, while the entire range of the species, as indicated by the stations, is from 40 to 65 degrees.

Nearly all the stations in the red-fir region are found between 50 and 55 degrees. Indeed, outside of this group the stations are but scattering.

In the redwood region all the stations are between 50 and 60 degrees.

Woodland shows a high temperature, nearly all the stations

being between 55 and 65 degrees—that is, at the highest temperatures represented.

The upper limit of tree growth, or the timber-line, is a matter of temperature, and is not difficult of definition. In the "American Journal of Science" for 1882, page 275, I published an article entitled "The Timber-Line," in which I showed that the mean annual temperature of the timber-line in the United States is one or two degrees below freezing-point. The data for this result are as follows:

Given the height of the timber-line in feet, the height and the mean annual temperature of a station at or near the base of a mountain, and the fact that the mean annual temperature diminishes about three degrees in each thousand feet of ascent, the calculation of temperature of the timber-line is a very simple matter.

The result above given, which is set forth fully in the article referred to, is corroborated by more recent and extended investigation, and the separate results show a range of only four or five degrees. The fact that in different parts of the country the timber-line species differ does not appear to affect the result, since the same figure is obtained for Mount Washington, New Hampshire, Mount Marcy, New York, the mountains of Colorado and Montana, the Sierra of California, and the Cascade Range of Oregon and Washington.

The conclusion reached, that the timber-line has a mean annual temperature of approximately 30 degrees, makes the location of this isotherm a simple matter.

RAINFALL.

States.	Average Rainfall in Inches.				
	Yellow Pine.	Fir.	Redwood.	Desert Species.	Open Country.
Arizona	23	..	..	15	9
Colorado	..	..	..	..	14
California (North)	44	..	44	30	18
California (South)	30	..	57	19	11
Idaho	24	..	..	..	12
Montana	21	..	..	..	15
New Mexico	..	..	..	20	11
Nevada	..	..	..	..	7
Oregon	31	56	..	..	13
Utah	..	..	..	16	11
Washington	21	56	..	..	15
Wyoming	..	..	..	..	12
Average rainfall of total stations	34	56	46	24	13

OPEN COUNTRY.

NUMBER OF STATIONS IN EACH RAINFALL GROUP.

STATES.	−10″	10″–15″	15″–20″	20″+
California	39	47	33	15
Wyoming	6	18	2	..
Nevada	20	3	1	..
Oregon	2	6	5	..
Washington	3	3	9	1
New Mexico	10	12	4	..
Arizona	22	14	3	..
Colorado	8	18	26	..
Montana	..	15	11	1
Idaho	3	10	1	1
Utah	15	13	7	.
Totals	128	159	102	18

YELLOW PINE.

NUMBER OF STATIONS IN EACH RAINFALL GROUP.

STATES.	−20″	20″–30″	30″–40″	40″–50″	50″–60″	60″–70″	70″+
Arizona	..	2	..	..	..	..	..
California	1	8	5	8	8	3	1
Montana	1	3	..	.	..	..	..
Washington	2	5	..	..	..	..	..
Oregon	1	5	3	2	..	..	..
Idaho	2	5	1	..	..	..	..
Totals	7	28	9	10	8	3	1

RED FIR.

NUMBER OF STATIONS IN EACH RAINFALL GROUP.

STATES.	−30″	30″–40″	40″–50″	50″+
Washington	3	7	7	13
Oregon	..	8	13	19
Totals	3	15	20	32

REDWOOD.

NUMBER OF STATIONS IN EACH RAINFALL GROUP.

STATE.	−30″	30″–40″	40″–50″	50″
California	1	7	4	5

DESERT SPECIES.

NUMBER OF STATIONS IN EACH RAINFALL GROUP.

STATES.	−20″	20″–30″	30″
California	13	25	16
New Mexico	2	1	..
Arizona	6	..	..
Utah	2	..	..
Totals	23	26	16

The data relating to rainfall are more definite and much more significant than those of temperature. The table presenting the average rainfall of the different regions shows that the average of the open country is 13 inches and that of the different States ranges from 7 inches in Nevada up to 18 inches in northern California. The average rainfall under which yellow pine grows, as indicated by these data, is 34 inches, but owing to the irregularity in the distribution of stations its true average should probably be somewhat greater. The different States show for yellow pine a range from 19 inches in Wyoming up to 44 inches in northern California. The average rainfall of the red fir in Oregon and Washington is 56 inches and that of the redwood is 46 inches. In both these cases the figures probably represent very closely the facts. Desert species, with an average of 24 inches for the entire West, shows a range among the States from 15 inches in Arizona up to 30 inches in northern California.

These rainfall stations have been classified in groups of ten inches of rainfall, or, in the case of open country, by five inches. For the open country this classification shows that nearly all the stations—indeed, 96 per cent. of them—have less than 20 inches of rainfall, which appears to indicate that where the rainfall exceeds 20 inches one may expect to find the country wooded. Nearly all the stations in which the rainfall exceeds 20 inches—*i. e.*, fifteen out of eighteen stations—are found in California, and many of them are in the upper part of the Sacramento Valley.

Of the stations in the yellow-pine country, nearly all—fifty-nine out of sixty-six—are found where the rainfall exceeds 20 inches. This appears to indicate that the lower limit of the yellow pine is at or just below 20 inches of rainfall. The upper limit is not clearly defined, owing, probably, to scarcity of stations in the higher country. In California one station at least is found

where the rainfall exceeds 70 inches, and there are twelve in which the rainfall exceeds 50 inches.

In the regions occupied by the red fir only three stations out of seventy are reported as having a rainfall less than 30 inches. This appears to indicate that the lower limit of the red fir is at or about 30 inches of rainfall. There is apparently no upper limit, the fir being found abundantly in regions where the rainfall exceeds 100 inches annually.

The redwood strip on the California coast includes but one station having a rainfall less than 30 inches, which appears to indicate that the isohyetal line of 30 inches is the lower limit of this species.

DRAINAGE MODIFICATIONS IN THE SOUTHEASTERN APPALACHIANS.

The following is an abstract of a paper by Prof. Douglas Wilson Johnson of the Massachusetts Institute of Technology which has just received one of the Walker prizes of the Boston Society of Natural History:

From time to time mention has been made of a capture of the former headwater portion of the Chattahoochee River, by the upper portion of the Savannah River, at the border between western South Carolina and northeastern Georgia. In the summer of 1905 the speaker spent several weeks in a study of the region in question. The results of this study appear to justify the following conclusions:

(1) The upper portion of the present Savannah River formerly flowed southwest through the Chattahoochee River into the Gulf of Mexico, but was diverted to the Atlantic drainage by a process of stream capture.

(2) The capture furnishes an example of what may properly be termed "remote capture," having occurred so long ago that much of the direct evidence has been obliterated.

(3) The capture resulted from the advantage enjoyed by the Atlantic drainage over the Gulf drainage, owing to the shorter course to the sea which streams of the former system traversed.

(4) Both the Tallulah and Chattooga Rivers (now tributary to the Savannah) occupy to-day the same general courses which they occupied before the capture, the combined waters of both streams having been diverted at the same time by a single instance of capture, which took place a short distance below their point of junction.

(5) The falls of the Tallulah River, while initially due to the capture by a stream at a much lower level, exist to-day, not because of the recency of the capture, but because of the presence of a hard rock barrier crossed by the Tallulah River, but not yet worn down by it.

(6) The similar falls which must have existed on the Chattooga and larger tributaries have been obliterated by those streams, not because they were captured first, but because the great lapse of time since the capture was ample for them more nearly to grade their courses in the less resistant rock over which they run.

The evidence upon which these conclusions are based consists, in part, of the entrenchment of the Tugaloo, Tallulah, and Chattooga Rivers, the higher and more open valleys of the tributaries to the Chattahoochee, the hanging valleys bordering the three first-named streams and their larger tributaries, the difference in hardness of rocks in the Tallulah gorge as compared with the other valleys, and the presence of old river gravels across the divide between the Savannah and Chattahoochee systems at this point.

GEOGRAPHICAL RECORD.

AFRICA.

MAJOR POWELL COTTON'S EXPEDITION.—Reuter's Agency received news (May 25) from Major Powell Cotton's Expedition, which left England eighteen months ago on a journey from the Nile to the Zambezi. At the end of March the explorer and his wife were at Makala, Congo Free State, in the heart of the Ituri rubber district and one of the chief haunts of the okapi, where the expedition proposed to remain for a month or so in a final endeavour to secure specimens. The progress of the expedition has created much interest among the pygmy and other forest tribes, Mrs. Powell Cotton being the first European woman to penetrate the Ituri basin, and the camp has been thronged daily with natives curious to see the "white woman with the long hair." The explorers were in good health and were receiving every assistance from the authorities.

ASCENTS IN THE RUWENZORI RANGE.—The BULLETIN reported in the June number (p. 368) that three gentlemen had reached one of the peaks of the range. Information has since come almost simultaneously to London that the Duke of the Abruzzi has begun his ascent, and also that in April last Messrs. R. B. Woosnam, D. Carruthers, and A. F. R. Wollaston, three members of the zoological expedition sent to Africa under the auspices of the Natural History Museum, South Kensington, made two ascents in the Ruwenzori Range. On April 1, according to *Nature* (No. 1910, p. 132), they ascended Duwoni, the peak rising to the northeast of the Mubuku Glacier. This peak has two tops of apparently equal altitude; the southern top, which was reached, was found to be 15,893

feet. On April 3, they ascended Kiyanja, the peak at the western end of the Mubuku group of peaks. The altitude was found to be 16,379 feet. The altitudes were taken by aneroid and by the boiling-point thermometer. Both these peaks have been thought by different explorers to be the highest points in Ruwenzori, but from the summit of Kiyanja a still higher peak with two tops was seen in a northwesterly direction. The weather at this season of the year is very unfavourable, the mountains being almost constantly buried in clouds, with frequent snowstorms, which prevented the party from making further explorations.*

PROGRESS OF THE CAPE TO CAIRO RAILROAD.—On June 11, the British South Africa Company in London received a message that this railroad had reached the Broken Hill mines on that day. The Broken Hill mines consist of two low hills which are practically a solid mass of copper ore. The British South Africa Company has a large force of European miners there. One of the hills is being cut away by terracing and a tunnel has been cut through the other hill. The ore which the miners have accumulated may now be carried away for reduction. The railroad has been extended 2,016 miles north from Cape Town, and its completion to Broken Hill forms a further step towards the fulfillment of Mr. Rhodes's great scheme. Progress has been remarkable since the tracks crossed the Zambezi. The mileage completed north of the river is 374, and construction has been carried forward at the rate of nearly a mile a day. From 3,000 to 5,000 natives were constantly employed under the supervision of about 350 whites. Seven bridges were built of over 50-feet span, and the bridge across the Kafue River is 1,200 feet long. It is expected to extend a branch road into Katanga, the southeastern province of the Congo Free State, where the greatest gold and copper region of Central Africa is said to exist. This region has been explored by mining experts; but scarcely any development work has been done, owing to lack of communication with the rest of the world.

AMERICA.

DR. BAUER'S NEW POSITION.—The Carnegie Institution recently offered to Dr. L. A. Bauer the post of permanent Director of its Department of Terrestrial Magnetism. He has accepted the offer, and will hereafter devote his entire time to the Carnegie Institution work. For the past seven years he has been in charge of the magnetic survey and observatory work of the United States under the auspices of the Coast and Geodetic Survey. He organized and trained a corps of observers, established five magnetic observatories, and began the magnetic work of the Coast Survey vessels. Under his direction the general magnetic survey of the United States has been practically completed, the three magnetic elements having been observed at about 2,500 stations distributed over the United States and outlying territories. Various publications relating to this work have been issued.

The Carnegie Institution work, however, is developing into a general magnetic survey of the globe. The annual grants to the Department of Terrestrial Magnetism are sufficient to keep continuously in progress an oceanic magnetic survey in addition to the sending of expeditions to land areas where no magnetic surveys have as yet been made and also to carry out various auxiliary investiga-

* A telegram of July 5 from Rome announced that the Duke of the Abruzzi reached the summit of Mount Ruwenzori on the 18th of June.

tions. It is believed that this magnetic survey of the globe will be completed within the next fifteen or twenty years.

WHAT IS KNOWN OF ALASKA.—Mr. Alfred H. Brooks of the U. S. Geological Survey writes in the *Popular Science Monthly* (Jan., 1906) that of the total area of Alaska, 620,000 square miles, just about one-half, or 310,000, is still unmapped and practically unexplored. The explorations of the U. S. Geological Survey have covered about 80,000 square miles; the geological and topographical reconnaissance surveys, 60,000; shore-line surveyed by Coast Survey and some geological surveys by the Geological Survey, 120,000; and explorations by other departments of the Government, 50,000. All but two of the larger rivers have been surveyed, and contour maps have been made of over 150,000 square miles. All of the larger geographical features have been outlined by the network of explorations which have been extended over the entire Territory. There are no mountain ranges yet to be discovered, though several are still imperfectly known. Every mining district in Alaska has been reported upon, and inquiries in regard to the mineral resources of any part of Alaska are answered with a printed report issued by the Geological Survey containing the latest and most authentic information. Much still remains to be done, for over half the Territory has not yet been covered by even reconnaissance surveys.

WORK ON THE TRANSANDINE RAILWAY.—Mr. John Hicks, U. S. Minister to Chile, has written to the Department of State that the section of this railway from Salto del Soldado to Juncal has been opened to traffic. This is the railway over the Andes to connect the cities of Buenos Aires and Valparaiso, and will be the first road south of the Isthmus of Panama to join the two oceans. It is being constructed jointly by the Republics of Chile and Argentina. The portion of the line still uncompleted is only about ten miles in length; but it includes a long tunnel through the summit of the Andes, and it is estimated that it will take at least three years to complete it. Travel on this road began as early as 1888, when the two ends of the railway were 75 miles apart. From the Argentine end to Buenos Aires the track is in good condition, and the journey is made in twenty-four hours. As yet, however, transit across the mountains is only possible in the summer season on account of the snow, which accumulates during the winter months in immense quantities and frequently descends to the lower levels in the form of avalanches. It is said that the ordinary snowshed of the Rocky Mountains will be worthless here, and the construction of tunnels or other means of protection strong enough to safeguard the track so that trains may run in winter is an engineering problem not yet satisfactorily solved.

THE CENSUS OF THE CITY OF BUENOS AIRES.—The City Government of Buenos Aires has issued a large octavo volume, of 557 pages, in French, under the title "Recensement Général de la Ville de Buénos-Ayres," giving the results of the census of 1904, with discussions of every phase of the work of the municipal administration and of the city's social condition, commerce, and industries. Buenos Aires has long been notable for the excellence of its statistical compilations, its *Monthly Bulletin* giving all the statistics for each month. The population on Sept. 18, 1904, was 950,891, having increased 287,037 in nine years and four months. According to recent figures, the population of the capital on Dec. 31, 1905, was 1,025,653—an increase of 74,762 in less than fourteen months, showing that the population is still rapidly growing.

In territorial extent the city surpasses Berlin and Paris, but is exceeded by London and Vienna, the latter being now the largest city in area on the European mainland, though its density of population is less than in many of the larger cities. There are in Buenos Aires 51 inhabitants to the hectare (2.47 acres), while Paris has 340, London 145, New York 202, Berlin 285, Vienna 89, Brussels 204, and St. Petersburg 135 inhabitants to the hectare. Over one-third of the residents of Buenos Aires, or 320,589 persons, were born in the city. Many of the inhabitants, since 1895, have moved out of the more crowded districts into the peripheral territory, to which electric tram cars afford cheap transportation, while cheap lands, low rents, and purer air are attractive inducements. There were 17,985 commercial houses containing merchandise and fixtures worth 520,706,300 pesos (a peso=95.5c.) and giving employment to 79,547 persons, of whom 64,154 were men and 15,393 women. It is an interesting fact that persons of foreign birth form a large majority of the employés, foreigners numbering 49,951 and Argentines 29,496. The book is illustrated with a map of the city and a considerable number of photographs, including a fine panoramic view of Buenos Aires as seen from above the new docks on the river front.

Savage Tribes of the Amazonian Region of Peru.—Mr. von Hassel claims to base his knowledge on ten years of intercourse in the forests of the Marañon and Amazon. He gives a profusion of names which he calls tribal, and makes some remarks on customs and languages.—(*Boletin de la Sociedad Geográfica de Lima.* Año XV, Vol. XVII, first quarter, 1905.)

ASIA.

Dr. Sven Hedin's Journey through Persia.—The Bulletin (May, 1906, p. 311) announced the arrival of Dr. Sven Hedin in Seistan after a very fruitful journey, in the course of which he crossed the Dasht-i-Kavir, the great salt desert, three times. Letters have since reached England from which the London *Times* (No. 1,534, weekly edition) prints more details of the explorer's experiences. When he left Sweden in October last to travel to India, *via* Turkish Armenia, Persia, Seistan, and Baluchistan, he intended to make only a hurried journey through those countries, as his main field of work lay on the other side of the Himalayas. He found the opportunities for exploration between Teheran and Seistan so tempting, however, that he was nearly four months instead of two months on the road, and worked harder than ever before in the field.

From Veramin, a little southeast of Teheran, he went to Siah Kuh or Black Mountain and Kuh-i-Nakshir, where he found the western edge of the Dasht-i-Kavir as sharply drawn as any shore-line. He describes the desert as like the bottom of a big inland lake, full of salt mud and presenting an absolutely level surface. After turning aside to visit the Haus-i-Sultan lake, the explorer travelled in a generally southeast direction to Yandak, on the southern border of the Dasht-i-Kavir. Here he left his main caravan, and, taking two men and four camels, marched north across the desert to Turut, afterwards crossing south again to Khur. Rain fell, and the camels could go only slowly through the salt mud, so that Dr. Hedin made most of the journey on foot.

He says he has been able to construct a very good map of the Dasht-i-Kavir, of which the mapping thus far has been quite inadequate. From Khur he con-

tinued his journey eastward to Tubbas, one of the most charming oases he ever saw, with veritable forests of palm trees. Thence he passed southeast to Naiband, an even more delightful spot than Tubbas, turning aside *en route* for a couple of days' excursion into the Bahabad desert, which was marked on the maps as unexplored. From Naiband he proceeded to Neh, and thence to Nasretabad in Seistan.

He says that the explorer may still find plenty of work in eastern Persia. He carefully mapped the country along his route, and was able to make several corrections in earlier maps. His map work occupies 162 sheets, and in addition he made a panoramic sketch of the surrounding mountains at every camp from which mountains were visible, or at fifty out of sixty-eight halting-places. Most of these panoramic views are eight feet in length, and some of them are coloured. In addition, he made more than 100 sketches of typical Persian figures and secured between 400 and 500 photographs. Specimens of rocks were collected to the number of 200, and at two places fossils and molluscs were found. As usual with Dr. Hedin, written observations form the main part of his results, and on this journey he compiled 1,200 pages of manuscript notes. The plague was raging in Seistan when he arrived there in the early part of April. Writing on April 14, Dr. Hedin announced his intention of leaving Nasretabad two days later for Nushki, whence he proposed to make his way across India to Simla.

THE SURVEY OF INDIA.—A Committee was appointed in 1904 to examine the methods and workings of the Survey of India Department with special reference to the revision and reproduction of the topographical maps of the country. The report of the Committee has been issued in two volumes as "Report of the Indian Survey Committee, Parts I and II, 1904-1905," illustrated by a considerable number of maps. It goes into the history, methods, and cost of the survey, the state of the maps in each province, and the measures required to bring them up to date.

The gist of the Committee's recommendation is that the Department be strengthened in all that pertains to the topographic or military mapping of India and that the Topographical Survey be hereafter separated from the Cadastral or revenue survey, which shall in future be undertaken by the local civil administrations under supervision from the central Department.

Everything will be secondary in importance to the paramount necessity for maintaining a complete and thoroughly up-to-date one-inch map of all India and of all the frontier within the Indian political sphere of influence. With regard to map reproduction, the Committee recommends the partial engraving of maps and the introduction of heliozincography to replace the crude processes of photozincography. In accordance with the recommendation of the International Geographical Congress for the preparation of maps on the scale of 1:1,000,000, the Indian Survey has thus far issued a few sheets on this scale, and the Committee believes that its continuance may be sanctioned for the whole interior of India.

ARCHÆOLOGICAL SURVEYS IN INDIAN BORDERLANDS.—The Government press at Peshawar has issued a quarto volume of 56 pp. with 12 photographic plates containing Dr. Stein's report on his "Archæological Survey Work in the North-West Frontier Province and Baluchistan." The report gives fresh evidence of Dr. Stein's indefatigable industry and of the wide range of his erudition. He has been examining the ancient sites and traditional remains on the North-West

Frontier of India, and has apparently left nothing unvisited that might contribute to the interest of Indian archæology. One question which was thought to be settled he leaves involved in doubt. The situation of the celebrated rock fastness of Aornos, the capture of which figures so prominently in all classical accounts of Alexander the Great's campaign on the Indian frontier, was supposed to have been determined by the researches of the late Col. Abbot, who decided that it must have occupied the heights of Mahaban. Dr. Stein proves, however, that there is nothing in common between Mahaban and the rock described by Arrian, and no trace can be found on top of the mountain of the plateau described by the classical historians.

Besides disposing of Mahaban, Dr. Stein has rendered valuable service by identifying the site of Buddha's "body offering," or the holy spot where he offered his body to feed a starving tigress—a site which for ages was one of the most sacred bournes of Buddhist pilgrimage. Applying his gift of topographical analysis and his remarkable knowledge of legendary lore and oriental scholarship to his observations, Dr. Stein has no hesitation in assigning the site of that ancient gathering-place of the faithful to the hill of Banj, south of Mahaban. He found here ruins that coincide closely with the detailed description of the sacred "temple of the collected bones" and its surroundings.

Time Zones in China.—The Imperial Maritime Customs of China, some time ago, called attention to the advantage of time zones, which had already been introduced in Japan and the Philippine Islands. In accordance with the suggestion, China proper was divided into two zones, the western of which is called the seven and the eastern the eight hour zone east of Greenwich. The eight-hour zone comprises all the provinces between 112° 30′ and 127° 30′ E. Long. The seven-hour zone includes all the provinces of China proper west of 112° 30′ E. Long. The eight-hour zone thus includes all the treaty ports along the coasts from Newchwang in the northeast to Swatow in the south and the river ports as far west as the great Yangtse port Hankow.

A difficulty arose with the time zone at the treaty ports of Canton and Samshui because they are in close relations with Hongkong and Macao, where local time was still in use. The Imperial Maritime Customs, therefore, communicated with the colonial authorities, and both colonies consented to be included in the time zone. For convenience it was also decided to include the treaty ports of Hoihao and Pakhoi in the eight-hour zone, though both are west of the zonal dividing line. The clocks of Hongkong were put ahead 23 minutes and 8 seconds.

Most of the people do not yet realize the advantages of the time-zone system, but it is expected that they will soon learn to appreciate the ease with which they may reckon the time in every other place; and there is no doubt that the importance of this reform will increase with the development of railroads and the ultimate connection of the Chinese lines with the railroad net of Siberia and Europe.—(Condensed from *Mitt. der K. K. Geog. Gesell. in Wien,* Vol. 49, Nos. 3 and 4.)

EUROPE.

The Bernese Oberland.—The May number of the *Deutsche Alpenzeitung* is entirely given to description of the various parts of the Bernese Oberland illustrated by half-tone photographs and coloured plates that are a conspicuous feature of this periodical. One of the photographs is a splendid view of the northwest

front of the Wetterhorn with the valley and village of Grindelwald in the foreground; another view shows the remarkably serrated surface of the upper part of the Grindelwald glacier with the bordering flank of the Schreckhorn. The coloured views include the Finsteraarhorn and the Oeschinensee, which, in its setting of mountains, is one of the finest of the smaller Alpine lakes. The Jungfrau narrow-gauge railroad is now half built, and was utilized through the season last year (four months) by 73,333 passengers.

INTERNATIONAL CONGRESS FOR THE STUDY OF THE POLAR REGIONS.—This Congress will be held at Brussels in September, 1906. The meetings will take place Sept. 7, 8, 10 and 11, at 10.30 A.M. and 2.30 P.M. each day.

Government delegates, delegates of Academies, Institutes and learned Societies and persons who have been upon the staff of a scientific expedition to the polar regions will be enrolled as *Acting Members,* without payment of any fee. All others pay a subscription of 20 francs and will be admitted as *Honorary Members.*

A lady's ticket is placed at the disposal of each member.

A circular of information will shortly be sent.

Those Members and ladies provided with tickets, who put their names on a special list, will take the train at 8.21 A.M. on the 12th of September for Paris, and on the 14th Sept. at 9.20 A.M. for Marseilles, where, on Saturday the 15th, they will take part in the Closing Reception of the Alliance Française and Geographical Societies and visit the Colonial Exhibition.

The French authorities have intimated their intention of offering a complimentary excursion in the Mediterranean.

Applications for membership to be addressed to M. Lecointe, Observatoire royal de Belgique, à Uccle, Belgium.

THE NEW PORT IN WALES.—A new port will be opened in August at Fishguard, on the Pembrokeshire coast of Wales, overlooking St. George's Channel. At a spot where the sea, a few years ago, washed against the sides of the hills, a deep-water port has been created by blasting out the rock to a depth of 150 feet and using the débris to build a long breakwater. The Great Western Railway Company has completed a railway station, galleries along the sea wall to facilitate the landing of cattle, and six miles of railroad tracks and sidings. The natural protection afforded to the harbour by the hills on three sides of the fine bay is completed by the breakwater, which will have a length of 2,500 feet. The water area of the harbour thus perfectly protected is 500 acres. Travellers by this new route to South Ireland will be able to leave London after breakfast and reach the Lakes of Killarney the same evening. The London *Times* (weekly, June 1) says it is believed that Atlantic liners bound for Liverpool or Glasgow will find it to their advantage to call at Fishguard, and thus save time, especially with regard to mails and passengers.

POLAR.

THE EAST GREENLAND EXPEDITION.—The Danish Government and private citizens have raised about $70,000 to fit out the proposed expedition under the leadership of Mr. L. Mylius Erichsen to East Greenland. The party sailed from Copenhagen June 29 and will make its way as far north as possible along the east coast of Greenland. The purpose is chiefly to map the unexplored part of the east coast and to look for anthropological remains. The leader expects to winter on the coast, and, from the most northern point of Greenland, he will attempt,

in the spring of 1907, to reach the Pole. In his opinion the highest point of Greenland is the most favourable place from which to make this attempt. His northern sledge expedition will return in time to winter on the ship during the second year. In March, 1908, Mylius Erichsen, accompanied by one of his staff and two Greenlanders, hopes to traverse the inland ice across the broadest portion of the island. He thinks he may make this journey in about two and a half months, travelling partly by motor car, partly by dog sledge, and partly on ski.

THE PEARY EXPEDITION.—Many who are interested in Peary's enterprise are already beginning to ask when news may be expected from him. Under the most favourable circumstances, news cannot be expected earlier than September. If he is successful in reaching the Pole, and all circumstances are as favourable as might be conceived—which is not probable—a cable dispatch from him at the telegraph station in South Labrador may announce in September his good fortune and his return to civilization. If no news from him is received next fall it will be pretty good evidence that he requires another year at least to complete his work. If he does not come home this year it is not improbable that we may still have news from him. If, as is hoped, he succeeded in reaching his proposed headquarters on the shore of the Arctic Ocean, it may be that he started a small party of Eskimos south last spring giving news of the winter experiences of the expedition. If such dispatches were sent south they would be held at Cape York for the arrival of the Dundee whalers, and would reach America by cable from Dundee in November next. In this case Mr. Peary's friends and the geographical world will have information of his winter in north Grant Land. Unless he was able to carry out his sledging programme last spring we are not likely to hear of his final results for a year to come.

MR. A. H. HARRISON'S EXPEDITION.—Mr. Harrison, who started for the Mackenzie delta last year for the purpose of exploring the western part of the Parry Archipelago and looking for land in unknown Polar waters, writes to the *Geographical Journal* (June, 1906) that he left Athabasca Landing on July 22, 1905, in a boat built to transport his supplies and reached the Arctic Red River on Oct. 4th, where he was stopped by ice. During the winter he made a short-route survey, with perambulator, prismatic compass, and sextant, of the winter trail from Red River to the Peel, down the latter from Fort McPherson to its mouth, and up the Mackenzie to the Red River again. Observations for latitude and variation were made on this journey as well as during his descent of the Mackenzie. The winter was early, the snow exceptionally deep, and temperatures of —68° Fahr. occurred. To avoid losing a year, he left his goods behind and went on to Herschel Island in February, finding Lieutenant Hansen and the members of the *Gjöa* excepting Captain Amundsen, who had gone to Eagle City. Mr. Harrison hoped to make his way in April to Baillie Island and thence to Banks Land, where he proposes spending next winter.

VARIOUS.

GEOGRAPHY IN COLUMBIA UNIVERSITY.—In addition to the courses in physical and regional geography in Teachers College, Columbia University, under charge of Professor Dodge, a lectureship in Historical and Political Geography has been established in the University, and Prof. E. L. Stevenson of Rutgers College has been appointed to the position. While still continuing his work at Rutgers,

Prof. Stevenson will carry on two courses at Columbia: a course for undergraduates in political geography, in which the influence of geographical environment upon the history of people and States will be emphasized, and a course for graduate students on the expansion of geographical knowledge—a subject that will include both the growth of geographical conceptions and the development of cartography. Prof. Stevenson's lectures will be begun in October.

COMMERCIAL STUDIES IN THE UNIVERSITY OF WISCONSIN.—The Society has received from the University of Wisconsin *Bulletin* 126, which gives the course in commerce for the coming academic year. These studies include a number of topics of geographical importance, such as transportation, the consular service, commercial geography, and physical geography and physiography. The course was opened to students at the beginning of the academic year 1900-1901. The attendance, liberal from the beginning, has steadily increased and the number of students in the past year was 225.

THE UNIVERSITY OF MONTANA BIOLOGICAL STATION.—A *Bulletin* of the University announces the eighth session of its Biological Station at Flathead Lake from July 11 to Aug. 16. This Station has become well known to American naturalists, and fifteen States have been represented in the early sessions. It is near the shore of Montana's large inland lake, which spreads over 300 square miles; the rapids of Swan River are at the door, and snow-capped peaks are near at hand. The Station will give courses in zoology, botany, photography, nature study, physiography, and special research. Eastern students who desire further information may address Morton J. Elrod, Director, Missoula, Montana.

Dr. Henry E. Crampton, Professor of Zoology in Barnard College, Columbia University, has returned from a scientific expedition of three months to the island of Tahiti in the Society group. He went for the American Museum of Natural History to study various species of mollusca which have undergone individual evolution in the isolated valleys of that island.

Edward Brückner, Professor of Geography in Halle University, has been called to the Chair of Physical Geography in Vienna, vacated by Prof. Penck. Together with Penck, he wrote "Die Alpen im Eiszeitalter" (1901-03). Both in physiography and hydrography he has shown himself to be a scientific investigator of original power.

Dr. Albert E. Jenks has been elected to an Assistant Professorship in the Department of Sociology at the University of Minnesota. He was recently chief of the Ethnological Survey of the Philippine Islands, and wrote the notable report on "The Bontoc Igorot," published by that Survey and reviewed in the BULLETIN (p. 575, 1905).

D. W. Johnson, Assistant Professor of Geology at the Massachusetts Institute of Technology, has been appointed Assistant Professor of Physiography at Harvard University.

Mr. Willis Moore, Chief of the U. S. Weather Bureau, has received the degree of Doctor of Science from St. Lawrence University.

The Royal Geographical Society of Australasia, Queensland Branch, celebrated the twenty-first anniversary of its foundation in the last week of June.

The Paris Société de Géographie has presented one of its gold medals to Major C. H. D. Ryder for his services as surveyor and explorer in connection

with the recent Tibet Mission and his expedition to the sources of the Brahmaputra.

The *Geographical Journal* for June reports the proceedings at the meeting of the Royal Geographical Society on the 9th of April, when the American Ambassador presented to Captain Robert F. Scott, R. N., the Cullum Geographical Medal awarded to him by the American Geographical Society for the voyage of the *Discovery* and his sledge journey to Lat. 82° 17′ S., 1901-1904.

DR. JOSEPH KÖRÖSI DE SZÁNTÓ, founder and for forty years director of the Statistical Bureau of Budapest, died in that City on the 23rd of June after a long illness, at the age of 62 years.

Dr Körösi was also director of the Library of Budapest and a member of the Hungarian Academy of Sciences. His name was known and respected in many lands.

U. S. BOARD ON GEOGRAPHIC NAMES.—DECISIONS June 6, 1906:

ALEXAUKEN: creek, tributary to Delaware river at Lambertville, and railroad station, Hunterdon County, N. J. (Not Alexsocken.)

AMARGOSA: range, Inyo County, Cal.

ARENA: creek, flowing into San Luis Lakes, Costilla County, Cal. (Not Meadow nor Rito Arena.)

BEAR: creek, Jefferson County, Colo. (Not Turkey.)

BEAR: creek, Montezuma County, Colo. (Not South Fork Dolores nor Bear river.)

BECKWITH: pass, through Sierra Nevada near Chilcoot, Plumas County, Cal. (Not Beckwourth.)

BELTED: peak, most northerly high summit of Belted Range, Nye County, Nev.

BIRCHRUNVILLE: village, in West Vincent Township, Chester County, Pa. (Not Birch Run Ville nor Birch Runville.)

BLACKHEAD: peak, in San Juan Mountains, Archuleta County, Colo. (Not Corona.)

BRIER: spring, in Grapevine Mountains, Nye County, Nev. (Not Wild Rose.)

BRISTOW: town, Prince William County, Va. (Not Bristoe.)*

CLARK FORK: river, in Montana, Idaho, and Washington. (Not Silver Bow, Silverbow, Deer Lodge, Deerlodge, Hell Gate, Hellgate, Missoula, Bitter Root, Bitterroot, nor Clarks river.)

COCHETOPA: creek, hills, pass, town, precinct, and forest reserve, in southwestern Colorado. (Not Cochetopah.)

COTTONWOOD: creek, a left-hand branch of San Luis Creek, Saguache County, Colo. (Not Wildcherry.)

CRATER: flat, between Joshua and Bear Mountains, Nye County, Nev.

CRESTONE: creek, Saguache County, Colo. (Not Crestones.)

CRYSTAL: creek, flowing into the Black Canyon of the Gunnison, Gunnison County, Colo. (Not Rio Contrario.)

CURECANTI: creek, a right-hand branch of Gunnison river, Gunnison County. Colo. (Not Vincennes.)

DOLORES: mountain, in Dolores County, Colo. (Not Dunns Peak.)

EAST: river, a right-hand branch of Gunnison river, in Gunnison County, Colo. (Not Slate.)

* Reversal of former decision.

EMIGRANT: wash, southwest of Mesquito Flat, Inyo County, Cal.

FARALLON: islands, off the coast of California. (Not Farallones de los Frayles, Farallone, nor Farallones.)*

FUNERAL: mountains, part of the Amargosa Range, south of Boundary Canyon, Inyo County, Cal.

GATO: creek, Conejos County, Colo. (Not Gata nor Los Gatos.)

GOLD: flat, west of Quartzite Mountain, Nye County, Nev.

GRAPEVINE: mountains, part of the Amargosa Range, north of Boundary Canyon, Inyo County, Cal.

GRAPEVINE CANYON: pass, through Amargosa Range, Esmeralda and Nye counties, Nev. (Not Bethune Pass.)

HAYWARDS: town and railroad station, Alameda County, Cal. (Not Haywards Station, Hayward's, Hayward, nor Haywood.)

HIGBEE: canyon, Otero County, Colo. (Not Reilly's.)

HORSEFLY: creek, a right-hand branch of San Miguel river, Montrose County, Colo. (Not Muache.)

HUERTO: creek, a right-hand branch of Rio Piedra, Hinsdale County, Colo. (Not Middle Fork Piedra.)

JARRE: creek, a left-hand branch of Plum Creek, tributary to South Platte river, Douglas County, Colo. (Not Garber nor Jug.)

KEYSTONE: bay, west of Keweenaw point, on the south side of Keweenaw Peninsula, Keweenaw County, Mich. (Not Union.)

KEYSTONE: point, west of Keweenaw point, on the south side of Keweenaw Peninsula, Keweenaw County, Mich.

LA VETA: peak, Sangre de Cristo Range, Huerfano County, Colo. (Not Veta.)

LONE CONE: peak, San Juan Mountains, Dolores and San Miguel counties, Colo. (Not West Point.)

MARBLE: canyon, Panamint Range, Inyo County, Cal.

MESQUITE: flat, in Death Valley, Inyo County, Cal. (Not Mesquite Valley nor Northwest Arm Death Valley.)

MIDDLE: creek, a left-hand branch of Cucharas river, Huerfano County, Colo. (Not Locust.)

MILBANK: city, Grant County, S. Dak. (Not Millbank.)

MOOYIE: river, Kootenai County, Idaho. (Not Methow nor Moyea.)*

MOUNT OSO: peak, San Juan Mountains, Hinsdale County, Colo. (Not Hunchback.)

MOUNT WILSON: peak, San Juan Mountains, San Miguel County, Colo. (Not Glacier.)

MOSCA: creek, Saguache County, Colo. (Not Sand.)

OBSIDIAN: butte, on Pahute Mesa, Nye County, Nev.

OLD BALDY: peak, Sangre de Cristo Range, Costilla County, Colo. (Not Baldy.)

PAHUTE: mesa, Nye County, Nev.

PILLAR: spring, at foot of Quartzite Mountain, Nye County, Nev.

PINE: creek, a left-hand branch of South Cherry Creek, Douglas County, Colo. (Not Piney.)

PINEY: creek, a right-hand branch of Cherry Creek, Arapahoe County, Colo. (Not Pine.)

POQUONOCK: village, railroad station, lake, river, and plains, New London

* Reversal of former decision.

County, Conn. River, tributary to Bridgeport Harbor, Fairfield County, Conn. Village, in Hartford County, Conn. (Not Poquonock Bridge, Poquonoc, Poquonnock, Pequonnock, Pequonnoc, Pequannock, Poquanoc, nor Poquannoc.)

PUCKETA: creek, Westmoreland and Allegheny counties, Pa. (Not Big Pucketa, Big Pucketta, Puckety, Poketo, Paucatoes, nor Pocatoes.)*

QUEEN ANNES: county, Maryland. (Not Queen Anne nor Queen Anne's.)*

REDCLOUD: peak, Hinsdale County, Colo. (Not Red.)

RIO BLANCO: river, a left-hand branch of San Juan river, Archuleta County, Colo. (Not Rio Blanca nor White.)

RIO GRANDE PYRAMID: peak, San Juan Mountains, Hinsdale County, Colo. (Not Simpson.)

ROEDER: creek, a right-hand branch of Bear Creek, tributary to Turkey Creek, Clear Creek County, Colo. (Not South Fork Bear.)

ROSE: spring, in the southern part of Kawich Range, Nye County, Nev. (Not Wild Rose nor Wild Horse.)

ST. CATHERINES: island and sound, Liberty County, Ga. (Not St. Catherine's nor St. Catherine.)

ST. CHARLES: town, Pueblo County, Colo. (Not San Carlos.)

SAPINERO: creek, a right-hand branch of Gunnison river, Gunnison County, Colo. (Not Indiana.)

SARCILLO: canyon, Las Animas County, Colo. (Not Zarcillo nor Sarcilla.)

SARCOBATUS: flat, north of Amargosa Range, Nye County, Nev. (Not Mirage.)

SILENT: canyon, south of Gold Flat, Nye County, Nev.

SKELETON: hills, west of Specter Range, Nye County, Nev.

SKULL: mountain, north of Specter Range, Nye County, Nev.

SLATE: river, a right-hand branch of East river, tributary to Gunnison river, Gunnison County, Colo. (Not East.)

SOUTH RIVER: peak, San Juan Mountains, Mineral County, Colo. (Not Macomb.)

SPECTER: range, Nye County, Nev.

SUCKER: creek, a tributary of Snake river, Malheur County, Oreg., and Owyhee County, Idaho. (Not Snake nor Succor.)

SURFACE: creek, a right-hand branch of Gunnison river, Delta County, Colo. (Not East Fork Winnemucca.)

TAYLOR: river, a right-hand branch of Gunnison river, Gunnison County, Colo. (Not Spring.)

THIRSTY: canyon, in Pahute Mesa, Nye County, Nev.

TIEN SHAN: mountains, Turkestan. (Not Thian Shan, Tian-Shan, Thian-Shan, nor T'ien Shan.)*

TIJERAS: village, Las Animas County, Colo. (Not Tijera nor Tijeres.)

TONGUE: creek, Delta County, Colo. (Not West Fork Winnemucca nor Forked Tongue.)

TROUT: lake, San Miguel County, Colo. (Not San Miguel.)

TURKEY: creek, a left-hand branch of Arkansas river, Pueblo County, Colo. (Not Big Turkey.)

WEST ELK: creek, a right-hand branch of Taylor river, Gunnison County, Colo. (Not Illinois.)

WHEELBARROW: peak, the highest summit of Belted Range, Nye County, Nev.

YUCCA: mountain, west of Forty-Mile Canyon, Nye County, Nev. (Not Joshua.)

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* Reversal of former decision.

ALASKA.

Barwell: island, in Resurrection Bay. (Not Cape.)
Bowser: creek, flowing into Cook Inlet.
Brown: creek, flowing into Cook Inlet.
Bruin: bay, Cook Inlet. (Not Bear.)
Caines Head: cape, Resurrection Bay.
Cheval: island, in Resurrection Bay. (Not Horse.)
Culross: island, in Prince William Sound. (Not Grant.)
Douglas: mountain, near Cape Douglas.
Dry: bay, Cook Inlet.
East Glacier: creek, flowing into Cook Inlet.
Gompertz: channel, between East Foreland, and North Foreland, Cook Inlet.
Hive: island, in Resurrection Bay. (Not Guard nor Sugar Loaf.)
Iliamna: bay, lake, town, and volcano.
Iniskin: bay, in North shore Kamishak Bay, west shore Cook Inlet. (Not Innerskin, Inniskin, Inerskin, Initskin, Inischen, nor Enochkin.)
Lowell: point, Resurrection Bay.
Middle Glacier: creek, flowing into Cook Inlet.
Oil: bay, Cook Inlet.
Pilot: rock, in Resurrection Bay. (Not Light House.)
Renard: island, in Resurrection Bay. (Not Lowell nor Fox.)
Rugged: island, in Resurrection Bay. (Not Baker.)
Salmo: rock, off Mouth of Kenai River.
Seward: town, Resurrection Bay.
Susitna: river (tributary from the north to Cook Inlet), mountain and village. (Not Sushitna nor Sushetna.)
Thumb: cove, Resurrection Bay. (Not Dickinson.)
Tuxedni: harbor, Cook Inlet. (Region immediately south of Chisnik Island.) (Not Snug.)
Ursus: cove, Cook Inlet. (Not Bear.)
West Glacier: creek, flowing into Cook Inlet.

NEW MAPS.

AFRICA.

ABYSSINIA.—Sketch Map to Illustrate the Journey of Herbert Weld Blundell in the Abai Basin, 1905. Scale, 1:1,000,000, or 15.7 statute miles to an inch. Geog. Jour., London, June, 1906.

The Abai is the upper part of the Blue Nile. The explorer travelled, particularly in the southern part of the basin, from near the point where the river turns west to the place where it leaves Abyssinia. The map is constructed from a prismatic compass traverse supplemented by plane-table sketches, the distances being obtained from the rate of travel.

AFRICA.—Jährliche Regenmengen auf dem Festlande von Afrika. Scale, 1:25,000,000, or 394.5 statute miles to an inch. By G. Fraunberger. *Pet. Mitt.,* Vol. 52, No. 4, 1906, Gotha.

Illustrates Dr. Fraunberger's paper on annual precipitation in Africa. This is one of the maps which, some day, will have historic interest as pioneer attempts to record various classes of phenomena relating to the continent. Dr. Fraunberger uses eleven colours to show the distribution of precipitation as recorded in the reports of the rain stations, many of which have been established in parts of Africa, while others are scattered over wide areas. Such stations now exist, for example, at Basoko, New Antwerp, Stanley Falls, Bolobo, Brazzaville, Leopoldville, Matadi, Boma, and Banana on the banks of the Congo. Insets give the same information on a larger scale for the Cameroons coast and the Usambara district in German East Africa.

ANGLO-EGYPTIAN SUDAN.—Provisional Map of Khartoum City, Khartoum North, and Omdurman. Scale, 1:253,440, or 4 statute miles to an inch. Compiled for the use of the Khartoum Mudiria by Lieut.-Col. E. A. Stanton, Governor Khartoum Province. Two sheets.

Col. Stanton has compiled this well-drawn and excellently-printed map from various sources. The scale is sufficiently large to show the important buildings, markets, ruins, and other features of Khartum and Omdurman, with the plots of cultivated land, the sand dunes, and other topographic features. It is the first map to make fully intelligible all the information now accessible with regard to this important centre. It supplies a need, and it will be worth while to introduce its most essential features on some of the best atlas sheets.

ANGLO-EGYPTIAN SUDAN.—Stations at which Rainfall was measured in 1905 in the Basin of the Upper Nile. Scale, 1:7,500,000, or 118.3 statute miles to an inch. Survey Department, Cairo, 1906.

Accompanies the Report on "The Rains of the Nile Basin in 1905" by Captain H. G. Lyons. The map distinguishes between stations where rainfall was measured and those where only rainy days were recorded. Rain records were kept last year at 62 stations in the Nile basin and 14 in British East Africa. The latter are not in the Nile Basin, but are important to show the variation of the rainfall in different areas.

EGYPT.—Topographical Map of Giza Province. Scale, 1:10,000, or 0.1 statute mile to an inch. 49 sheets. Cairo, Survey Department, 1905.

This map, finely drawn and engraved, is on so large a scale that an extraordinary amount of detail is inserted. Forty-nine sheets of the map have thus far been printed on this scale. Much of the nomenclature is given both in English and Arabic.

KAMERUN.—Provisorische Karte der Gebirgslandschaften des Militärbezirkes Fontem. Scale, 1:100,000, or 1.5 statute mile to an inch. By M. Moisel. *Mitt. v. Forschungsreisenden u. Gelehrten aus den Deutsch. Schutzgeb.* Vol 19, No. 1. Berlin, 1906.

This is a compilation of the surveys made in a district of West Kamerun by eleven German officers between 1897 and 1905. Routes are given and the drainage and relief, and the positions of towns, market-places, and many farms are shown.

ZULULAND.—Map of Zululand. Compiled from surveys by L. M. Altern, A. Hammer, and F. A. Middleton. Scale, 1:158,400, or 2.5 statute miles to an inch. 6 sheets. Surveyor General of Natal and Zululand, Pietermaritzburg.

This is the best map of Zululand yet produced, and is desirable material for improving the atlas maps of this part of South Africa. It will ultimately be supplanted by a more detailed survey, but meanwhile it presents much information not hitherto accessible. Hills are shown in brown form lines and the rest of the map is printed in black. Heights are in figures, and mission stations, kraals, offices of the magistrates, European houses, trigonometrical points, forts, telegraph lines, railroads, common roads, and much other information are clearly given. Some of the details are a little unusual. One place on a river is marked "trees thrown into water whereon natives pass." A "conspicuous sandslip," "remarkable square topped hill," tall trees," and "flagstaff fallen down" are among the sights along the ocean.

AMERICA.

Hydrographic Office Charts.

Pilot Chart of the North Pacific Ocean, July, 1906.

Pilot Chart of the North Atlantic Ocean, June, 1906.

The reverse shows the route followed by the U. S. Dry Dock *Dewey* on her passage, under tow, from Chesapeake Bay as far towards her destination (Luzon) as the Suez Canal; also a list of the 35 U. S. naval wireless stations in working order on the Atlantic and Pacific Coasts and their islands, and the 11 wireless stations of the Canadian Government on the Atlantic Coast and islands. These stations are shown on the face of the pilot charts.

New Jersey.—Topographic Map of New Jersey. Scale, 2,000 feet to an inch. (Somerville, Pluckemin, and New Brunswick Sheets.) Contour interval in level country, 10 feet; in hilly country, 20 feet. Geological Survey of New Jersey, Trenton, 1905.

Further sheets of the new map of the State described in the Bulletin, p. 499, 1905. The maps are the result of recent surveys, and contain practically all the features of the one-inch maps, with much new material.

Argentina.—Plan de la Ville de Buenos Ayres. Scale, 1:28,000, or 0.45 statute mile to an inch. By the Department of Public Works. Buenos Aires, 1904.

A photographic reduction of a large municipal map. Notable buildings and places are indicated by figures referring to explanatory text. The map shows the entire street plan and differentiates those streets which have not yet been opened. It illustrates the volume "Recensement Général de la Ville de Buénos-Ayres."

Canada.—Verbreitung der deutschen Abkommenschaft im Kanadischen Bunde 1901. Scale, 1:7,500,000, or 118.3 statute miles to an inch. By Dr. Paul Langhans. With insets of southern Manitoba and Ontario, on a scale of 1:3,700,000, or 58.3 statute miles to an inch. *Deutsche Erde,* No. 2, Gotha, 1906.

Shows in colours the percentage of German residents per 100 inhabitants in each district of Canada, based upon the Fourth Census, 1901. Illustrates an article by Prof. A. Oppel on "Das Deutschtum in Kanada."

ASIA.

Dutch East Indies.—Schetskaart van een deel van het eiland Seran. Scale, 1:500,000, or 7.8 statute miles to an inch. By F. J. P. Sachse. *Tijdschrift* of the Royal Netherlands Geographical Society, Vol. 23, No. 3, Amsterdam, 1906.

Shows with considerable detail the recent surveys of the western and most of the northern sides of Ceram. Upon these surveys are based the change in the form of this island as it appears in the ninth edition of Stieler's Hand-Atlas. The boundary between the north and south administrative districts mainly follows the water-parting between the north and south flowing streams.

Japan.—Carte de l'Empire du Japon. Scale, 1:3,000,000, or 47.3 statute miles to an inch. Imperial Press, Tokio, 1905.

Illustrates the annual *Report* of the Minister of Finance on Japan's financial and economic condition. It fully shows communications by land and sea, and

gives—what is rare on atlas sheets of Japan—the headquarters of the army divisions and the military ports.

JAPAN.—Mission Map of Japan. Scale, 1:1,250,000, or 19.7 statute miles to an inch. Compiled by H. M. Landis. Methodist Publishing House, Tokio, 1904. (Price 75c., postage 9c.)

An excellent map of Japan based upon Government surveys and showing the chief geographical features—roads, sea routes, etc.—in addition to a large amount of information about missions, chiefly their distribution and the populations of the large number of centres which they occupy.

SINGAPORE.—Map of the Island of Singapore and its Dependencies. Scale, 1:63,360, or 1 statute mile to an inch. Colonial Engineer's Office, Singapore, 1904.

The scale of this map in colours is large enough to admit of much detail, such as the various kinds of roads, railways in operation or proposed, forest reserves, altitudes above sea-level, and other data.

PALESTINE.—Stanford's New Orograpical Map of Palestine. Compiled under the direction of H. J. Mackinder. Scale, 1:253,440, or 4 statute miles to an inch. Edward Stanford, London, 1906. (Price, coloured sheets, 16s.; mounted on rollers and varnished, 20s.)

This map is equal to the best of the previous works in this series. Thirteen shades of brown show heights from sea-level to 9,000 feet above it, three shades of olive green show land below sea-level, and three shades of blue indicate various depths of the sea. Confusion is avoided by thus using one colour only to show one kind of facts. A distinction is made between perennial streams and merely occasional torrents. This map, while especially prepared for schools, is adequate for most reference purposes, and is one of the best generalisations yet made from the surveys of the Palestine Exploration Fund and other sources of information. Precise data fail only in the east and especially toward the south-east, where the broad washes of colour give facts only with approximate truth. Asia will soon appear in this orographical series, and North America is now in preparation.

EUROPE.

SCOTLAND.—Map of Kingussie District. Scale, 2 miles to an inch. *Scot. Geog. Mag.*, Edinburgh, June, 1906.

Illustrates a paper by Miss Newbigin on this part of the Scottish Highlands. Altitudes shown by four brown tints and white.

SWITZERLAND.—Spezialkarte des Exkursionsgebietes von Bern. Scale, 1:75,000, or 1:18 statute mile to an inch. By H. Kümmerly and Frey. Geographischer Kartenverlag, Bern, 1905. (Price, paper 3 frs., linen 4 frs.)

One of the excellent maps which this Swiss firm is constantly producing for tourists. The topographic relief is shown by a combination of contours (100-feet interval) and shading the light coming from the northwest so that the south, southeast, and east slopes of the mountains are in shadow. The large scale permits the great variety of information required by the tourist to be plainly indicated by symbols. It would add interest to such maps if the valley as well as the summit elevations were given in figures, so that the differences in height might be determined more quickly than by counting the contour lines.

SWITZERLAND.—Carte des Nivellements de Précision de la Suisse. Scale, 1:1,000,000, or 15.7 statute miles to an inch. Swiss Geodetic Commission, Bern, 1905.

Shows the lines of levelling carried out between 1865 and 1903, and the work done by each of the branches of the service engaged in it. The map illustrates a report on this work of the Department of the Topographic Survey in the Swiss Geodetic Commission.

ATLASES.

ANDREES ALLGEMEINER HANDATLAS.—In 139 Haupt und 161 Nebenkarten, nebst vollständigem alphabetischem Namenverzeichniss von etwa 240,000 Namen. Fünfte, völlig neubearbeitete und vermehrte Auflage. (Lieferungen 31-36.) Herausgegeben von A. Scobel. Velhagen & Klasing, Leipzig, 1906. (Price of complete work, M. 28.)

This new edition is rapidly approaching completion. Among the maps in these six parts, the "Südpolargebiete," on the scale of 1:30,000,000, is the largest and one of the best Hand-Atlas Charts of the Antarctic yet published. Five colours are used to denote sea depths. Positions of the great ice wall extending eastward from Erebus Island are given according to Borchgrevink in 1900 and Scott in 1902. "British Nordamerika und Alaska," on a scale 1:12,500,000, shows as much detail as may be clearly presented on this scale. It includes the proposed new Canadian trans-continental line with its branch to the Klondike; Alaska is an excellent compilation of the latest data. In Labrador, the Naskaupi, Northwest, and George Rivers are laid down as though they were completely explored, while on the sheet of the Canadian Geological Survey they are shown in broken lines, and the latest information, soon to be published, will make important changes in the mapping of these rivers. "Südwestliche Vereinigte Staaten und Nördliches Mexico," one of the four sheets of the United States, on a scale 1:5,000,000, shows that this map of our country will be very serviceable to American purchasers, for a great deal of detail is given with the utmost clearness, though the scale might with advantage have been larger. As the railroads are printed in red, the eye follows them with the utmost ease. "Mitteleuropa, Physische Übersicht," scale 1:3,500,000, is a fine generalization of the topographic forms of the European mainland between the Baltic and the Danube, the English Channel, and the Carpathians. This Atlas has always excelled in its African maps, and pp. 159-176 in this edition are devoted to that continent. "Nordwestliches Afrika," on a scale of 1:10,000,000, gives all details which the scale permits, and shows how much has been done in the past few years, especially by Germany and France, to collect new facts for the maps. The sheet of "Südbayern, Vorarlberg, Tirol und Salzburg" is so dark that many of the names are not easily read.

ATLAS OF THE WORLD'S COMMERCE. COMPILED FROM THE LATEST OFFICIAL RETURNS AT THE EDINBURGH GEOGRAPHICAL INSTITUTE. EDITED BY J. G. BARTHOLOMEW. (Part 5.) George Newnes, London, and Frederick Warne & Co., New York. (Price per Part, 25 cents.)

Two map sheets are given to wool and coal—4 wool and 5 coal maps. The map showing the distribution of wool growing distinguishes between areas producing British wools, cross-bred wools, fine wools (merino), coarse wools, goat's wool, and camel hair. The inset maps show the distribution of sheep, with density to the square mile, in the British Islands, the United States, and Cape

Colony. The letterpress and diagrams on the back of the sheet relate chiefly to the industry in the United Kingdom. The coal map shows in red the coal districts in all lands. The United States inset shows coal distribution on a larger scale and distinguishes between anthracite, bituminous, and lignite. Other insets show the coal districts of the United Kingdom and the export ports, the coal districts of Germany, Belgium, and France, and the importing countries, chief of which are Canada, Scandinavia, France, and Australia. The back of the sheet presents a general summary of steel and coal, with diagrams. The description of the "commodities of commerce" is continued from "Gutta-percha" to "Leather." This fine work maintains its exceptional interest and value.

ACCESSIONS TO THE LIBRARY.

APRIL–JUNE, 1906.

AFRICA.

ARCHER, FRANCIS BISSET.—The Gambia Colony and Protectorate. An Official Handbook. (Maps and Illustrations.) London, St. Bride's Press. [1905?] 8vo.

BERTHOUD-JUNOD, MME. RUTH. Du Transvaal à Lourenço Marques. Lettres de ———, de la Mission Romande. Publiées par Gaston de la Rive et Arthur Grandjean. [Map, Portrait, &c.] Lausanne, Georges Bridel & Cie. 1904. pr., 16mo.

BRUCE, JAMES.—Travels to Discover the Source of the Nile in the Years 1768-1773. *Vol. VIII,* containing the Plates and Maps. Edinburgh, A. Constable & Co. 1805. 4to.

DU BOURG DE BOZAS, MISSION SCIENTIFIQUE. De la Mer Rouge à l'Atlantique à travers l'Afrique Tropicale. (Octobre 1900-Mai 1903.) Carnets de Route. Préface de M. R. de Saint-Arroman. Illustrations . . . Cartes. Paris, F. R. de Rudeval. 1906. 8vo.

EBERS, G.—Egypt: Descriptive, Historical and Picturesque. Translated from the Original German by Clara Bell. Introduction and Notes by S. Birch. (Illustrations.) New York, et al., Cassell & Co. 1882. 2 vols., folio.

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This is an enlarged and revised edition of a series of articles on Russia in Europe published by the author in the *Geographische Zeitschrift*. Its purpose is to expose the geographic foundations of the Russian people, state, and civilization, which, after a chapter on the physiography of the country of a more introductory character, are studied under the headings of the historical development and its results, the nations, the religions, the state, the settlement and population, transportation, industries, material and intellectual civilization, of the empire. As a study in anthropogeography it becomes of especial value through the discretion of the author in not trying to reduce every possible phenomenon to a simple geographic formula. Not many publications of this kind draw so clearly the line between geographic and non-geographic influences, and the way in which the author shows how the two have in different times co-operated with, or counterbalanced, each other constitutes one of the most interesting features of the book and gives it a methodical value just as great as its informational one. The keynote of the author's presentation is the fundamental difference between the Empire in the Russian lowland and the states of western Europe, together with their daughter states in the New World. As long ago as the 17th century this disparity caused Leibnitz to place Russia with Persia and Abyssinia, and it forms between Russia and western Europe a barrier larger than that between the latter and the other continents to this day. Russia's seclusion from the Atlantic, the oriental origin of her religion, the Asiatic character of her government—everything contributed to her having nothing in common with the West and its civilization. When the latter was at last artificially introduced it remained a mere superficial varnish of the upper classes, which only served to create a gap between them and the common people. Neither half knew how the other half lived; and their present needs are vitally different. The upper classes are modern men and women, whose ideals and capacities are equal to those of the most progressive nations; while the eighty per cent. of peasant popu-

lation can be compared only to the corresponding classes of Western Europe in the Middle Ages, before the peasant rebellions of the Age of the Reformation. Their immediate needs wil be remedied by better methods of government and a just distribution of the land; and those of the future by education, which will enable them ultimately to acquire also political privileges. In this and other respects, the book is an admirable example of scientific geographical study which "neither praises nor condemns, but tries to understand." M. K. G.

Immanuel Kant, Physische Geographie. Zweite Auflage. **Herausgegeben von Paul Gedan.** Philosophische Bibliothek, Band 51. Leipzig, Dürrsche Buchhandlung, 1905. (Price, M. 2.80.)

Kant at Königsberg and Gatterer at Göttingen were the first scholars who introduced geography as a science into the curriculum of the university, and for this reason Kant's Physical Geography will never lose its value as one of the fundamental documents of our science. This, and the fact that the book is based, not on the original manuscript of the author, but only on lecture notes of some of his hearers, has caused a considerable number of republications of the book by various scholars even after it had long lost its value as a source of information. This edition by Dr. Gedan is the latest of them, and shows a considerable number of corrections which bear testimony of how carefully every means of getting as near as possible to the author's true meaning has been utilized. In an introductory sketch the editor shows that the author of the Critique of Pure Reason was far from treating the subject only as a hobby or side-interest. He announced this course of lectures for no less than 47 semesters and read it in 29. He laid especial emphasis on the educational value of geography, emphasizing the need of a scientific treatment of the subject which should substitute careful examination of the facts for the credulous acceptance of marvellous tales, and he contributed to it himself by original investigations of geological, meteorological, and anthropological problems. In 1756, for instance, he discovered the law of the deviation of the trade winds, independent of Hadley; in 1754 he claimed the necessity of long geological periods in opposition to the theory of cataclysms; and in 1798, in his Anthropology, demanded "a natural history .... which would show the changes of the creatures of the earth being due to migration and subsequent deviation from a few original types," thus anticipating the ideals of Lyell, Darwin, and Moritz Wagner. In the plan of the book it is interesting that the author's conception of physical geography comprises physical geography, strictly speaking, as well as a short systematic zoology, botany, mineralogy, and regional geography of the countries. He evidently understood the term, as even some modern scientists do, as the scientific treatment of natural phenomena in contrast with the merely descriptive treatment. Beside this "physical geography" proper, he places as independent but correlated subjects mathematical geography, "moral" geography (the study of the ethics of the nations upon a geographic basis), political geography, commercial geography, and "religious" geography (the study of religions from a geographic point of view). Thus he approaches Humboldt in the universal conception of the subject, and it is certainly one of the most felicitous circumstances in the history of our science that, when his metaphysical work began to absorb him so as to put a stop to further researches in the concrete sciences, Humboldt was all ready to take up the work where Kant had left it. M. K. G.

La Guyane Inconnue. Voyage à l'Intérieur de la Guyane Française. Par Albert Bordeaux. Paris, Librairie Plon, 1906. iv–288. (Price, 3.50 fr.)

A tiny map, barely a sketch of the three Guianas—English, Dutch, and French—terminates a well-printed octavo volume. Its modest size is in harmony with the unpretentiousness of the author, and yet the little book has very substantial merits. It is *very* entertaining, has an abundance of local colour, and contains much solid information, mixed, of course, with a few glaring errors of small importance. Mr. Bordeaux, for instance, still believes that the porcupine may detach its quills at will; he is convinced that the condor exists in Guiana, that the tiger or jaguar also bears the name of puma, and the like. We may well pass over such mistakes if we take into account that he has not made the animals of tropical forests his special study, and hence relied upon information from the people who, as everywhere else, are not always the most reliable source. In regard to the tapir, that pachyderm must be much taller in Guiana than in other places, since Mr. Bordeaux, who saw and hunted it, compares it in size with a small horse or with a cow.

Mr. Bordeaux is a mining engineer, and one who has had much practical experience in many parts of the world; Chapter VIII (pp. 107 to 123) gives evidence of it. He knows prospectors as well as promoters and capitalists. But he is, above all, a good observer and an intense lover of nature. Such must be the case, indeed; for he could not otherwise be enraptured with several months of life in dusky forests where nature is an impediment, a constant threat to man. The forests of Guiana teem with life, and in this manner distinguish themselves from the timbered wildernesses of the upper Amazonian region, above the level where the great fluvial arteries begin to furrow the basin of Brazil and Bolivia. To Mr. Bordeaux every branch of organic life appeals, and his descriptions are candid, spontaneously eloquent. He leads us to the gold placers of interior Guiana; we feel with him the inconveniences and serious drawbacks of daily and nightly toil, in a climate where torrential rain is the rule nearly all the year through. But as he never complains and always finds mitigating circumstances for the worst of plights, never tries to make of himself a hero or a victim, our reading of his story is cheering, however uncomfortable the conditions may have been.

His stay in the placers has enabled him to furnish vivid pictures of these establishments, so little known to the outer world. Life in them is not altogether enticing, owing to climatological difficulties; but as the work is performed voluntarily, and for the sake of employment, nobody has a right to complain. He describes the methods, their advantages and drawbacks. We gather that the washings have produced thus far a sum of nearly fifty millions of dollars, all told. The difficulties of transit and transportation and the consequent cost of living are most serious impediments. The production has varied considerably from year to year, the first year yielding more than any of the succeeding ones.

Most instructive are his, tactfully short, remarks on the condition of the exiles, the number of whom he estimates at about six thousand. Those people appear to be, in fact, the favourites of the Government at Cayenne. They work less than others, and are almost excused from any sort of punishment. They have cost, since 1854, sixty millions of francs at least, and their work has hardly produced anything. It is well to treasure the following passages (p. 209): "When a routine lasts fifty or sixty years, and is tied to the changing influence

of a régime, France suffers on her part; there is neither strength nor time to perform durable work." He suggests that the criminals be sent elsewhere, "to the islands of Kerguelen, for instance, south of Africa, where, it is said, there are only seals and a Consul. The climate there is excellent."

These criticisms on the system of deportation and the ridiculous petting of the deported by the French Republic are but the prelude to a concise exposition of the real value of Guiana through its numerous natural resources, which the author cursorily enumerates, and the use which, under the system of government, is made of them. The impression caused by the contrast recalls, in the most striking manner, the conduct of France towards her former colony of Canada. The same neglect, the same abandonment of the most essential interests. Guiana, one of the richest (naturally) regions of the earth, is made to depend, not even on the mother-country, but on its neighbours, and especially on the United States, for most commodities of life. With the exception of gold-dust, it exports almost nothing. France, which consumes annually six to seven hundred tons of rubber, receives, of that amount, only a few tons from its colony of Cayenne, where rubber and the *balata* grow well. Cotton is abandoned, coffee and sugar have to be imported, and the duties which the French Government exacts on all such necessaries of life are exorbitant. The number of souls (deported not included) in Guiana is stated at about thirty-five thousand, and the smallness of this number (in proportion to the territory) is generally attributed to insalubrity. There is no doubt that the coast is not healthy; but if we can trust the figures given by Mr. Bordeaux, mortality in Guiana is not by any means as great as in Senegal, in Martinique, and in Guadeloupe. In the former region it is six and seventeen hundredths per cent., on the islands from eight to nine, in Guiana two and a half per cent. Statistics are not an absolutely sure criterion; still, with margin enough for error, the figures are in favour of Guiana.

Recent events in Guadeloupe seem to indicate a state of things in that island similar to what Mr. Bordeaux reports of Guiana. A. F. B.

The Log of a Sea Angler. Sport and Adventures in Many Seas with Spear and Rod. By Charles Frederick Holder. x and 385 pp. and Index. Houghton, Mifflin and Company, Boston, 1906.

Mr. Holder has long been known as a writer on natural history, and especially on zoological topics. Much of the sea-angling experience recorded in this volume was obtained during the years when the author was one of a party of scientific men who were studying the growth and development of coral reefs off the coasts of Florida and sending collections of corals, fish, shells, and other specimens to the Smithsonian and other institutions. These researches resulted in new discoveries regarding the growth of corals indigenous to the Florida reef; and there was plenty of time, too, for fishing exploits in the summer months, the best time for the sport, though the increasing heat drives most northern anglers home before the finest part of the season begins. Mr. Holder knows how to write for entertainment as well as edification, and his twenty-four chapters on many kinds of sea-game, including the man-eating shark and the Spanish mackerel, afford many vivid glimpses of this kind of diversion. It is agreeable to hear from him that the old dictum is still endorsed, that no gentleman will catch more fish than he knows will be utilized. While his Florida experiences supply the larger part of his reminiscences, he has drawn, also, upon other localities from Maine to Cali-

fornia. He says that the splendid-hued Spanish mackerel of the Mexican Gulf "is a gamy creature of most exasperating habit," whose sudden and fitful appearance off the coast always causes great excitement among the native fishermen. A short chapter is given to this fish, which, strangely enough, does not figure in the excellent index.

Down in Porto Rico. By George Milton Fowles. 163 pp. 17 Illustrations. Eaton & Mains, New York, 1906. (Price, 75c.)

Perhaps Mr. Fowles is optimistic, but he certainly gives many reasons for his firm faith that Porto Rico is on the highway to attain success in her efforts to become "a worthy member of the sisterhood of States." He gives in his book the results of first-hand information obtained by careful investigation, during a year on the island spent in studying the home life, institutions, and condition of the people. The book opens with a geographical description and historical sketch of the island, and then follow chapters on the homes of the people, their characteristics and customs, their education under the Spanish régime and, later, under our military and civil government, their morals and religion, the present industrial and political situation, and a summary of the results of the author's studies.

Mr. Fowles does not minimize the fact that there are causes of political discontent and various other difficulties in the way of Porto Rico's advancement; but he sees abundant evidence that the islanders are getting a start in the right direction. Already 60,000 children are receiving a common-school education, and present misunderstandings will disappear when the rising generation, understanding our institutions better, comes on the stage. The union of Church and State proved disastrous, but Porto Rico is now released from ecclesiastical bondage. Many thousands of the men and women have lived together though not legally united, but a great impetus has been given to the establishment of legal homes. Economic conditions are improving. This is one of the best books that has been written for all who wish to know more about Porto Rican conditions. The half-tone photographs are excellent, but the map is poor.

Archives Marocaines. Publication de la Mission Scientifique du Maroc. Par Maurice Besnier. 65 pp. and Map. E. Leroux, Paris, 1906. (Price, 2 fr.)

We have the French chiefly to thank for the additions that have been made to our knowledge of Morocco in recent years. This book is the result of diligent search among the writings of early geographers or of modern authorities who have written about them to find what the ancients knew of Morocco. The earliest allusions to Morocco seem to be found in Homer, whose island of the nymph Calypso is supposed to be the little island of Perejil in the Strait of Gibraltar. The author reviews the ancient documents relating to Morocco, taking up first those that describe the coasts and then those treating of the interior. Authors and documents later than the third century of the Christian era add scarcely anything to what was known by earlier writers. The incomplete and fragmentary information that the ancients transmitted to us is then discussed. It is found to be impossible to locate many points mentioned by the early geographers, but the author believes that future archæological research in Morocco will throw light on many questions.